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On July 1, 1892, the Krupp gun establishment, at Essen, had 25,200 employees, and these with their families made a total population of 87,900. Of these 15,300 lived in their own houses; 25,800 in houses owned by Krupp, and 46,800 in outside houses. The outlay for the firm for houses represents about $3,000,000, and on this about $62,575 is realized in annual rents, or about 2.1%, after deducting repairs, taxes, insurance, etc. In addition to the houses, Mr. F. A. Krupp has set aside a fund of 500,000 marks (about $125,000) to be loaned to workmen at 3% to build their own houses. The condition of borrowing is that the workman must have a yearly income of less than 3,000 marks, have shown three years of irreproachable service, have served his time in the army, and pay down 300 marks out of his own income. The money is to be repaid in semimonthly instalments with the mortgage, extinguishable in 25 years. The firm also manages a co-operative store on strictly cash basis, and since 1890 this store returns all profit to the purchasers by a pro-rata distribution before Christmas on the accounts carried on the passbooks. A sick fund is also established, to which the firm pays one-third. A pension fund also pays out now about $59,000 annually, and to this the firm gave 500,000 marks in 1890 for a pension for officers. In 1887 Mr. F. A. Krupp subscribed 1,000,000 marks as a fund the income of which was to be used to aid employees who had suffered misfortune and whose case was not reached by previous laws. A fund of 500,000 marks was also donated for the benefit of the citizens of Essen, with the capital invested in workmen's homes, and in 1877 a life insurance scheme was started which is now prospering.

A canal convention to discuss and promote the deepening of the Erie Canal is to be held in New York city on Oct. 10. Delegates from the New York Chamber of Commerce, the Produce and the Mercantile exchanges, Board of Trade and Transportation and the State Canal Union will take part.

A new drawbridge is being built across Newtown Creek at Meeker Ave., Brooklyn, N. Y., by the supervisors of Kings Co. and Queens Co., the bridge formerly occupying the same site having been condemned by the United States Government as an obstruction to navigation. The location of piers and abutments of the new bridge was approved by the War Department, and the bridge is on the skew, with an angle of 65° between the centre line of bridge and centre line of channel. The piers and abutments are of rockfaced limestone masonry, in large blocks, with pile foundations covered by grillage. The piles were sunk by the water jet process through sand to a depth of about 16 ft. The drawspan is a through-truss structure 200 ft. long, 22 ft. wide c. to c. of trusses, with two waterways 65 ft. wide in the clear. The depth of truss at centre panel is 30 ft. The ends rest upon masonry piers, and deck plate girders of 30 ft. and 50 ft. span respectively, connect the piers with the abutments. The center pier is 26 ft. in diameter, and has a fender pier of timber extending the whole length of the bridge when open, but without end rests for the span. The end bearings on the piers are adjustable in height by turning capstan headed screws (four in number), the head of each screw forming one of the corner bearings. The turntable is of the Pencoyd pattern, 22 ft. diameter, and the draw is intended to be operated by one man. The roadway is 20 ft. wide, floored with a lower layer of pine plank 3 × 12 ins. and a wearing layer of spruce plank 3 × 10 ins. The two sidewalks are outside the trusses and floored with oak. From the ends of the abutments will extend crib bulkheads on pile foundations. The substructure and superstructure were designed by Mr. John J. McLaughlin, and Mr. Oscar Erlandsen is the engineer in charge of construction. The contract for the entire work was let to Dean & Westbrook, of New York, at $94,850. The work will probably be completed within a few months.

A highly successful test of 850-lb. armor-piercing shells, the largest ever made in this country, was held at Indian Head on July 5. These shells were manufactured by the Carpenter Steel Company, and the two shells tested pass a lot of 250 made. The first shell was given a velocity of 1,300 ft.-sec., and penetrated 16 ins. of plate and backing and rebounded with but a slight distortion in the body of the shell. The second shell, with a velocity of 1,325 ft.-sec., passed through both plate and backing and fell 9 ft. in rear of the target. This shell was practically undeformed and could have been fired again. Three more shells from this group are to be tried soon upon the 17-in. barbette armor of the "Indiana." These shells contain no bursting charge and are intended for armor-piercing only.

Bids will soon be asked for furnishing the material for and laying a 24-in. submerged cast iron water-works intake about 2¼ miles long at Burlington, Vt., beneath Lake Champlain, in from 30 to 60 ft. of water. This pipe will be an extension of the present intake, which now terminates a short distance from the dock line. The extension of the intake or the securing of an entirely new source of supply has been advocated for many years by some of the citizens and city officials, as stated at some length in our issue of July 28, 1892. The specifications for the work will be so drawn as to leave all possible freedom to the contractor as regards methods of construction, including the laying of the pipe in the open lake or from the ice next winter. Mr. F. H. Crandall is superintendent of the works.

The incandescent lamp litigation is still under way, and Judge Lacombe, of the United States Circuit Court, on July 1 granted injunctions to the Edison Electric Illuminating Co., of New York, against the Holland House and the Hotel Imperial, prohibiting them from using incandescent lamps infringing the Edison patent, under which the company is sole licensee for the city of New York. The injunction was suspended in its operation for ten days to enable the hotels in question to obtain other means of illumination. These cases were the first that have been brought against users of the Edison lamp patent as distinguished from manufacturers, and the decision is said to be far reaching in its effects. It is of great importance, especially in view of the recent refusal of an injunction by Judge Hallett in St. Louis against a Western manufacturer. The decision will be regarded as a rule for all users of other than Edison lamps in the states constituting the second circuit, and other suits will be brought against other users similarly situated.

Work on the tunnel through the Palisades described in our issue of March 30, 1893, is making very satisfactory progress. At the east end 680 ft. of heading and 490 ft. of bench have been excavated, and at the west end 936 ft. of heading and 636 ft. of bench. Shaft A, near the east end, has been completed and the headings turned. At this shaft 114 ft. of heading and 58 ft. of bench west and 54 ft. of heading and 20 ft. of bench east have been completed. Work on shafts B and C was begun about June 1, and they have been sunk 73 ft. and 68 ft., respectively.

A 1,500-ft. span cableway is being erected by the Lidgerwood Mfg. Co., of New York, N. Y., for conveying material for the construction of the new dam being built by the South Gila Canal Co., near Sentinel, Ariz. The dam will be of stone masonry, 1,419 ft. long and 50 ft. high, and the cable will span its entire length. The walls at each end of the dam are 109 ft. high, and on those will be the towers for the cableway 70 ft. high each. The load to be carried is 6 tons. The size of the main cable is 2½ ins., and its deflection below the air line unloaded will be 85 ft. All the other ropes will be ¾ in. in diameter. The cableway will be operated by a 75-HP. special Locke engine, with 12¼ × 15-in. cylinders and drums 60 ins. in diameter. These engines will give to the load a vertical speed of 250 ft. per minute and a traveling speed of nearly 800 ft. per minute. This is the longest cableway ever erected, being 150 ft. longer than that erected by the same company at the Austin Dam (Eng. News, Jan. 26). It was designed by Mr. Spencer Miller, M. Am. Soc. M. E., engineer to the Lidgerwood Mfg. Co.

The most serious railway accident of the week was a head collision on the Philadelphia & Erie R. R., near Johnsonburg, Pa., July 8. A westbound freight train passed Ridgeway without orders and collided with an outbound freight train which had the right of way to Ridgeway. Both engines and 18 cars were wrecked. Three men were killed and five severely injured. Disobedience of train orders was the cause of the accident.

The bridge carrying the Great Northern Ry. over Moses Coulee, near Rock Island, Wash., was burned July 2, the eastern trestle approach having been set on fire by cinders from a train. The bridge was 934 ft. long and 135 ft. high. It comprised four truss spans resting on wooden towers seven decks high. The bridge was on a curve in the center of a big loop crossing the coulee, with long and high trestle approaches on each side. A footbridge over the canal at Cohoes, N. Y., gave way July 2 and two men were drowned. A trestle on the Ohio & Mississippi Ry., near Vincennes, Ind., was burned July 2, and a trestle, 100 ft., on the Philadelphia, Reading & New England R. R., near Rhinecliff, N. Y., was burned July 8.

A break in the Erie Canal bank occurred July 3, near Rochester, N. Y.

A violent storm of wind and rain at Chicago, July 9, caused considerable damage at the World's Columbian Exposition by blowing in windows and doors and drenching some of the exhibits.

The cold storage building at the World's Columbian Exposition was destroyed by fire on the afternoon of July 10 with an appalling loss of life, estimated, as we write, at 15 to 20, with as many more injured. The fire appears to have arisen wholly from imperfect construction of the central stack, which was some 200 ft. high, and the loss of life chiefly from the rash courage of the fireman, who rushed to the topmost point of the fire, near where the fire broke out, without stopping to consider means of retreat or to investigate how extensive the fire was. The entire tower seems to have been honeycombed with fire, even before it broke out. In the work of attempted rescue many acts of great heroism were committed, but unfortunately with little result. The building was not one for which the management was directly responsible, it having been erected under a concession, and it was apparently very carelessly constructed about the stack. It is also the only one on the ground which has any such cause for fire within it.

A masonry dam is to be built for the Boston waterworks in the town of Southborough, Mass. It is reported that the total length of the structure will be 2,000 ft. and its greatest height 75 ft. About 240,000 cu. yds. of earth and 13,400 yds. of rock excavation will be required. There will be 22,200 cu. yds. of rubble masonry, 14,800 yds. of concrete masonry, 13,300 sq. ft. of broken ashlar facing and various smaller quantities of different kinds of masonry. Bids for this work are wanted until July 17. Mr. Wm. Jackson, M. Am. Soc. C. E., is City Engineer of Boston .

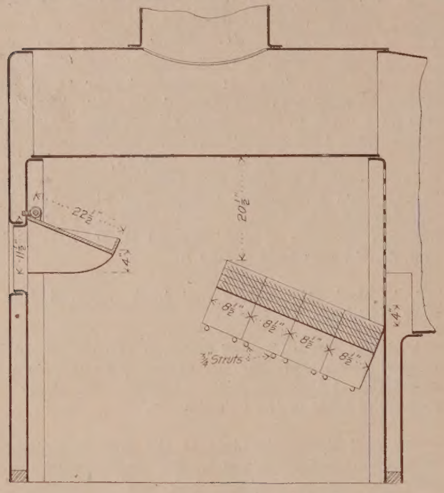
The term "glacial drift" in the contracts for the excavation of the Chicago drainage canal is causing trouble between the contractors and the Drainage Board. The price agreed upon by McArthur Brothers was 27½ cts. per yard for excavating this drift, which was defined in the contract as comprising "the top soil, earth, muck, sand, gravel, clay, hardpan, boulders, fragmentary rock displaced from its original bed, and any other material that overlies the bedrock." McArthur Brothers have now struck a substance hard and solid and apparently made up of conglomerated pebbles, gravel, sand and clay. It requires drilling and blasting, and the contractors demand "rock" price, or 88 cts. per cu. yd. They have quit work on their three sections until their claims are granted, and these claims would aggregate an addition of $5,000,000 to the contractor's bill, and granting it would mean a like claim from the other contractors. Engineer Randolph admits that the material is tough and hard to handle, but claims that it certainly comes under the definition for "glacial drift." The engineering and judicial committee of the Board is puzzling over the question.

An electric railway from Montreal to Quebec is spoken of as proposed by the Montreal Street Railway Co., an organization that now controls the street railways in Montreal, Winnipeg, Ottawa, Toronto and London.

LOCOMOTIVE FIREDOOR DEFLECTOR.

We are indebted to Mr. Wm. Smith, Superintendent of Motive Power and Machinery, Chicago & Northwestern Railway, for the accompanying drawings of a deflector used on some of the locomotives of that road for diminishing the amount of smoke which is thrown from the engines in hard service, and which is said to be giving very good satisfaction, resulting in some saving of both flues and fuel and causing very little trouble or expense. It is not claimed that the saving is large, but it is still noticeable. In an accompanying note Mr. Smith comments on some of the details of the service as follows:

We aim as a rule to have the deflector as nearly as possible in line with the lower side of the arch. We have four bricks in our arch in a 72-in. firebox. You will see there is a piece of iron used as a damper in the door. When the damper is turned upside down it leaves the slot free and open for admission of air; at the same time it forms a sort of a shield to keep out the light from the men's eyes. When we are firing up we generally close this damper by taking the damper out and reversing it, but at all times when the engine is working the damper is open in the firedoor. We put a lip on the end of this deflector so that it stands the heat better. If we run with the damper shut in the door, the end will burn off in a trip; but if the damper is kept open while the fire is fierce or the engine is working, it runs with us all the way from six weeks to three months. Roads having a foundry of their own will find that this is not a very expensive device, and not hard to put in. We generally slip the casting through the drop grate, as it will not go in through the door. When the deflector is burned out, of course, it then is returned to the scrap heap and melted for other use.



Locomotive Firedoor Deflector; Chicago & Northwestern Ry.

THE WORKS OF THE EAST JERSEY WATER CO. FOR THE SUPPLY OF NEWARK, N. J.*

(With inset.)

(Concluded from page 6.)

General Description of the 48-in. Steel Conduit.—No doubt the most novel part of the whole work is the 48-in. steel conduit, a riveted boiler shell 21 miles long.

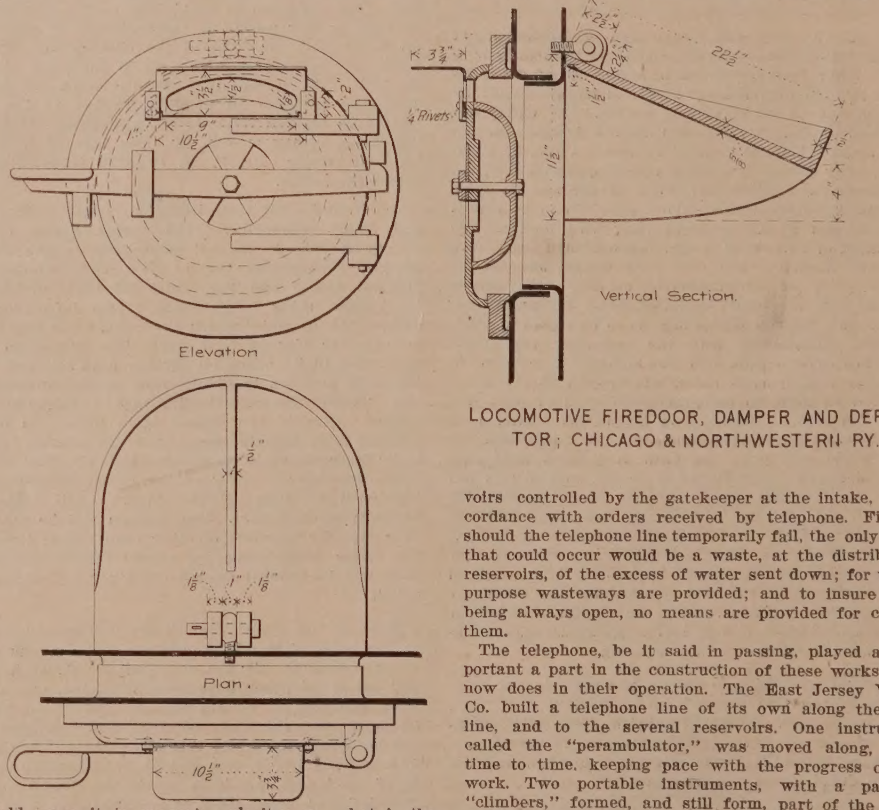
Such riveted pipes have been common in California for the past 30 years, and have been made of all sizes, from 10 up to 44 ins. in diameter. They are described in De Bow's "Hydraulic Mining" and in papers by Hamilton Smith Jr., M. Am. Soc. C. E., in the Transactions of the American Society of Civil Engineers, 1883 and 1884; also in "Hydraulics," by Hamilton Smith, Jr. (1886, Truebner & Co., London).

The city of Rochester, N. Y., built a riveted conduit 36 ins. and 24 ins. in diameter, in 1874, but this conduit has cast iron bell and spigot joints every 56 ft. This obviates the necessity of manholes, and avoids raising the question of expansion joints; so that the Rochester conduit is not a true riveted conduit of the California type. The conduit of the East Jersey Water Co. is, on the other hand, distinctly of that type, and is, besides, larger in diameter than any hitherto built in California, or anywhere else, of any great length, so far as known to the author.

One of the most startling features about these conduits is the entire absence of any mechanical contrivances to take up expansion and contraction. Prior to the construction of the works of the East Jersey Water Co. there was no precedent for such omission of mechanical contrivances to take up expansion and contraction, outside of California, so far as the author knows. The author made a journey to California principally to study this question on the ground; various designs of expansion joints, and of bell and spigot, and other forms of semi-expansion joints, or of joints made otherwise than by riveting, were also studied; with the result that, to the author, the promise of success was distinctly greater from the use of riveted joints than from any of the other kinds of pipe joint. Three winters' experience has shown no defect that can be traced to a lack of any mechanical appliance to take up expansion and contraction.

The phrase "mechanical appliance" has been used advisedly, for there is, of course, an adjustment of the forces produced in the body of the conduit by changes of temperature, though it is not brought about by any mechanical detail. This adjustment is self-acting, and is a compound of the friction of the pipe in the ground and of the elasticity of the metal forming the conduit. Computation will not reveal all the details of this action, but if, as may readily be done, the circular joints are made strong enough to safely resist the tensile strains that would be produced in the conduit supposing it anchored down at the two ends, during a variation of 45° F. (32°—77°), no trouble need be apprehended from expansion and contraction, as has been demonstrated in actual practice. Needless to say that, this plan once adopted, must be followed out consistently along the whole length of the conduit. Thus all stop-gates set in line of the conduit must have flanges and bodies sufficiently strong to resist the tensile strain produced in the conduit under the assumed variation of temperature of 45° F. The proper rule to follow the author believes to be to make such places excessively strong, so that the weakest points in the line shall be in the conduit itself, and not in any of its appurtenances.

The present was a case in which a high velocity in the pipe was desirable, as a matter of economy; there was plenty of fall available, and a proper use of it would cause it to generate velocity; or, what is the same thing, diminish diameter. The line followed gave 340 ft. head on the pipe; and those two elements combined gave 6 ft. velocity in a 4-ft. pipe, under 340 ft. head. These are measures which, if they do not positively exclude cast iron, yet raise grave questions as to the practicability of cast iron to meet them. Another objection to cast iron was the length of time that would be required to cast 21 miles of 4-ft. pipe, with all the foundries of large pipe in the country at work at it; or to lay it after it was furnished. And, finally, an estimate of cost was largely in favor of the riveted pipe, even excluding the idea of a combination of pipe foundries to fix prices as they might want them.



LOCOMOTIVE FIREDOOR, DAMPER AND DEFLECTOR; CHICAGO & NORTHWESTERN RY.

While on the subject of choice of pipe, it should be stated that inquiries were extensively made as to the state of the art of tubemaking, and whether any form of welded, or of seamless drawn, or of tube built up by processes other than by riveting, could be purchased, of desired quality and quantity, at an advantageous price, and within the desired time. While many such tubes were apparently on the point of being put on the market at advantageous rates, and some presumably will be at no distant day, no pipe was available in 1889 and 1890 which could compete with riveted steel pipe.

A novel feature of the pipe line is the fact that it has been designed and proportioned to resist, and is being operated to encounter, the pressures due to the hydraulic gradient only; in contradistinction to those which would be produced by a hydrostatic head. This idea, while so far as known here first embodied in a finished pipe line, had been previously suggested, as it now appears. Col. George H. Mendell, Corps of Engineers, U. S. A., proposed such a conduit for the city of San Francisco, in 1877; and Mr. Emil Kuichling, M. Am. Soc. C. E., now chief engineer of the Rochester Water-Works, who was assistant engineer in the construction of the Rochester Water-Works, in 1874, and again of the works of the East Jersey Water Co., in 1889-90, independently hit upon the same idea. To carry it out in practice, it is only necessary to regulate the quantity flowing through the conduit by a sluice-gate placed at the upstream end thereof, instead of by such a gate placed, as is usually done, at its downstream end. In the case of open canals for irrigation, or for water-power purposes, this has been the method of regulation since such works were first constructed, and it may have been merely the author's many years' training on water-power canals that led him naturally to think of like methods for a closed conduit.

That such an arrangement is well worth striving for will appear from the fact that in case of the works of the East Jersey Water Co., this simple change effected a saving of fully 40% in the weight; that is, in the cost of the manufactured conduit. At the present day, when the telephone has become one of the ordinary accompaniments of civilized life, there is no longer any excuse for building conduits any other way; so readily is the amount of water required in the distributing reservoirs controlled by the gatekeeper at the intake, in accordance with orders received by telephone. Finally, should the telephone line temporarily fail, the only harm that could occur would be a waste, at the distributing reservoirs, of the excess of water sent down; for which purpose wasteways are provided; and to insure their being always open, no means are provided for closing them.

The telephone, be it said in passing, played as important a part in the construction of these works as it now does in their operation. The East Jersey Water Co. built a telephone line of its own along the pipe line, and to the several reservoirs. One instrument called the "perambulator," was moved along, from time to time, keeping pace with the progress of the work. Two portable instruments, with a pair of "climbers," formed, and still form, part of the outfit of the engineer corps, and can be put in circuit anywhere on the line in a minute or two. The author has frequently sat down on the ground in some field or piece of woods along the line, called up his office in New York, had the stenographer read him his morning's mail, dictated the replies thereto, called up other parts of the work, or called up two or three foremen on the line for a simultaneous consultation by wire; they and the engineer corps habitually did the same thing, so that it can readily be seen how the telephone contributed no little to the speed with which the whole work, stretched over 35 miles in length of territory, could be carried on. For the filling or emptying of the conduit, and generally for the conduct of hydraulic operations on the pipe-line, the telephone has shown itself invaluable. It may be credited with having caused a distinct advance in the possibilities of practical hydraulics.

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*Abstract of a paper read before the New England Water-Works Association, at Worcester, Mass., June 14, 1893, by Mr. Clemens Herschel, M. Am. Soc. C. E., Engineer and Superintendent of the East Jersey Water Co. This paper, with discussion and many illustrations, will be published in full in the Journal of the New England Water-Works Association for Sept. 1, 1893.

Bridges.—The Pompton River and the canal immediately adjoining it are crossed by a four-span, ordinary wrought iron truss bridge, with the pipe hung on straps from the top chord. The Passaic River is crossed by a similar three-span bridge. All other brook and river crossings are either made by having the pipe support itself on spans not exceeding 10 ft. or by passing under.

Shut-Off Gates and Interlocked Blow-Off Valves.—There are on line of the 48-in. conduit nine 48-in. shut-off valves or gates, and two shut-off valves on line of the 36-in. pipe, besides the five 16-in. gates at the manifold to shut off the 36-in. pipe-line from the 48-in. conduit, at the junction of the two. These 48-in. valves are vertical valves with two 10-in. bye-passes, and are inclosed in little brick houses, forming at the same time tool-houses and depots of supplies along the line. The architecture of all the gate-houses is the work of Mr. Reuben Shirreffs, M. Am. Soc. C. E.

The 36-in. valves are horizontal, with 10-in. bye-passes, and are inclosed in underground vaults. In each case, excepting the two 48-in. valves furthest upstream, the valve gear is so interlocked with the gear of an appurtenant blow-off valve that the shut-off valve cannot be closed until the blow-off valve has first been opened; the blow-off valve cannot be shut again until the shut-off valve has again been opened. This is the arrangement adopted to prevent the possibility of an inadvertent closing of the shut-off gates while the water is running, or a turning on of the water while they are closed, the blow-offs being supposed shut in both cases; in either of which contingencies an excess of pressure would come upon the pipe upstream from the shut-off gate in question. As regards the first gate above noted as an exception to the rule, it is located at a point such that the conduit upstream from it can withstand the static head; and as regards the next gate downstream from this, being the one at the foot of Pompton Notch, it is not interlocked with a blow-off, because there is an open overflow pipe (shown by Fig. 12) on the hydraulic gradient in the Pompton Notch which would relieve the conduit from any excess of pressure caused by any possible handling of the gate at the foot of Pompton Notch.

A study and test of the ordinary relief valves made and in the market, also of designs for such appliances by competent engineers, was conclusive in showing their excessive cost and the risk of depending on such for the discharge of a possible 77 cu. ft. per second. Such relief valves are mostly held down by springs, and the water pressure to open them is an entirely different and a greater one, so long as they are yet shut, than the pressure which obtains to keep them open after they have once begun to discharge water; and, to make the matter worse, the action of the spring tending to hold them shut becomes stronger as they are lifted, so that none of them open very far or discharge any proper quantity of water at times when a copious discharge is needed, or is theoretically to be expected. Dead weights on the valves have the same and still other objections. Besides this, it must be remembered that relief valves in such a position would be expected to stand ready to operate for 20 years or more without deterioration, and yet be expected not to fail to act properly at the precise moment. The 48-in., 36-in., and interlocking blow-off valves and gearing were furnished by the Eddy Valve Co., of Waterford, N. Y., and have given entire satisfaction to date.

(Details of the shut-off and blow-off gates, with interlocking apparatus, are shown by Figs. 1 to 6, on the accompanying inset. Fig. 1 is an elevation of the two gates; Fig. 2 shows an enlarged sectional elevation of the shut-off and Fig. 3 of the blow-off gate; Fig. 4 is a plan of the main gate standard; Fig. 5 shows details of the locking pin and Fig. 6 of the cam which operates the interlocking gearing.

The normal condition of the 48-in. shut-off gate is, of course, open, in which case its interlocking gearing is held tight by the interlocking bar, which prevents the raising of the interlocking pin and thus the turning of the screw rod passing through it, and finally of the screw-rod of the gate, since this is geared to the screw-rod of the interlocking apparatus. The only means of unlocking the gate is the removal of the interlocking bar from above the locking pin, which cannot be effected until the blow-off gate is opened.

The locking pin is shown in elevation, plan and section by Fig. 5, and in position in the blow-off gate in Fig. 3, where it is lettered C. in the two elevations. In the side elevation, Fig. 3, the blow-off gate is unlocked and therefore the main gate is open and water passing through it. On opening the blow-off gate a slow motion is conveyed to the appurtenant interlocking gearing, as can be understood from the cam, cogwheel, etc., shown in plan in Fig. 4, this mechanism being duplicated at the blow-off gate. Each full turn of the blow-off gate wheel moves the cog in the interlocking gearing by only one tooth, but lowers the screw and the locking pin, C, to the position shown in the upstream elevation, Fig. 3. The locking pin thus clears the slot, D, and allows the operator to insert the locking bar through the slot and over the head of the locking pin, as may be seen more clearly from the side elevation in Fig. 3, where the dotted lines, E, represent the first position of the locking bar and the dotted lines above, its second position, after the head of the pin, E, has been lowered.

This movement of the interlocking bar unlocks the main gate operating apparatus so that it can be closed. Then when it is closed the interlocking bar locks the blow-off gate open in the same manner as it formerly held the main gate open. The blow-off gate, therefore, cannot be closed until the main gate has been opened.—Ed.)

Pressure Regulators.—At the two terminal chambers, or reservoir gatehouses, it was necessary to set relief valves or pressure regulators, although these pressure regulators at the reservoirs will become superfluous when the city of Newark completes its new special high-service distributing reservoir. This simple but excellent apparatus was made by the Ross Valve Co., of Troy, N. Y., and is shown by Fig. 7. The operating part is the small relief valve I, set at the required pressure by the hand-wheel H. When this valve opens an excess of pressure is formed in the chamber K, which depresses the main valve M, thus relieving the pressure that caused I to open. As a matter of safety, the piping and relief valve I is made in duplicate. As there are three pressure regulators in the Belleville gate-house, each of which is governed by two independent relief valves, there is a large measure of certainty of operation always at hand. Besides having the regulators set either in a locked up gatehouse, or else placed in charge of a keeper, the hand wheels are taken off from all the valves, and the appurtenant shut-off valves are all made with indicators, to show whether they are open or shut; these and a proper supply of recording and alarm and ordinary pressure gages being precautions against an improper or unauthorized handling of the apparatus.

The best arrangement would be to have a separate conduit for the high and for the low service; to have no means of shutting off the water, whether automatically, as in pressure regulators, or by shut-off gates within the terminal gatehouses; that is, to have the downstream end of the conduits always and of necessity wide open; and to have a reservoir at the desired elevation for the delivery of the water. This last condition is likely soon to be realized, upon which the other two are not unlikely to follow in course of time.

Automatic Air Valves.—The office of automatic air valves on a steel or wrought iron pipe line is to let the air out of the pipe when it is being filled with water; to let the air into it again when the pipe is drawn; also to let air into the pipe, and thus prevent the collapse of a long stretch of pipe, should, by any accident, such as a breakage of a blow-off connection, or of the pipe itself, a large quantity of water suddenly flow out of the pipe. To this has been added in the same casting an ordinary valve (Fig. 9), by means of which accumulated air may be let out of the pipe while it is in operation. The basis of the automatic air-valves (see Figs. 8, 9 and 10) is a brass cup, 3 11-16 ins. in outside diameter and 4 ins. high, turned bottom up, and light enough to float on water (see Fig. 8). The upturned bottom forms the valve disc, which is made to set up against the valve seat, when the cup, floating up between brass guides, and after the air contained in the pipe has been blown out, is reached by the rising water. The air imprisoned within the cup forms an air-cushion for this upward thrust. When the water leaves the cup, it at once falls down between the guides already mentioned, and thus leaves the whole area of the air valve open for the entrance of air. These cups are mounted in clusters of 4, 6 and 10, being the equivalents of 6-in., 8-in. and 10-in. connections, and each cluster is fitted with a valve (Fig. 9) to be operated by hand, as already mentioned. Under each cluster is a shut-off valve, to be used in case of any defect in the air-valves requiring repairs. The air-valves used were made by the Coffin Valve Co., of Boston, Mass., who also made the intake gatehouse, sluice gates and gatehouse ironwork generally—all of it, in the most satisfactory manner.

These air-valves were so proportioned that, in the event of the pipe being cut in two at the most dangerou point, the water rushing out and air rushing in would, between them, at no time cause more than one-half atmosphere of vacuum inside the pipe.

As the pipe was barely finished in 1891, there was no time to build underground vaults to keep these air-valves from freezing. Instead of these, there was designed a most wonderful structure (Fig. 10), as such things go, called an air-valve box. It must let air in freely and let air out freely, according as the pipe is drawn or is filled, but it must not allow the valve to freeze up. It must afford access to the hand-valve and to the air-valve, and must let air or water out when the hand-valve is opened, but, again, must not let any of the valves freeze up. It must let out the water that spills at the moment when the air-valves are shut by the rising water, or the possible larger quantities, should, from some obstruction or defect, one of the air-valves fail to close tight, but, again, must not let things freeze up by the route taken for the water to get out. The great American boy must be prevented from dropping stones or sticks into the boxes, and the shut-off valve must be so fitted that it can at any time be operated. A cellar pit is first built around the air-valves, and this is floored over with loose boards, or with panels of such. On this is laid a cheap form of quilt, made in two halves. The ordinary straw or other winter stuffing will not apply in this case, for fear of pieces of straw or other stuffing getting into the valves. Over this is the box proper, pierced by two or four wooden square chimneys, hooded to keep out the rocks and sticks. In these chimneys swing a flat plate of sheet iron, which shuts off the chimney when this plate is in a horizontal position. It is normally held horizontally, by a lead ball attached vertically beneath the center of the plate by a short wire rod, but will swing out of its horizontal position to pass a current of air going either up or down the chimney, and will duly return to the normal position when the air current ceases. Flap-valves in the several outlet pipes perform the same office of keeping out the cold, as far as they are concerned.* That no valve froze up during the very trying first two winters of the operation of the pipe is praise enough for the box.

(A few 2-in. air pipes were used on the 36-in. conduit, and are shown by Fig. 11.—Ed.)

Blow-Offs and Manholes.—Blow-offs were provided at all depressions so that the pipe could be emptied, and manholes placed at proper distances so that the interior of the pipe could be visited during and after construction. On the 48-in. pipe there are manholes every 1,000 ft., on the 36-in. pipe every 500 ft.

Manifold Connections.—To connect or branch off a 36-in. from the 48-in. pipe, as was done at Pompton Notch and at Belleville, the neatest way seemed to be by a series of 16-in. thimbles riveted to the 48-in. pipe, which were then gathered together again into the desired 36-in. pipe, as is shown by Fig. 13.

Venturi Water Meters.—As the main 4-ft. conduit is to supply several municipalities, a metering of the water carried by it and by its branches had to be provided for. For this purpose there exists, so far as the author knows, but one practical meter at the present day, described by him in the Transactions of the American Society of Civil Engineers, November, 1887, and June, 1888, which articles describe also the carefully conducted tests of a 108-in. meter, discharging nearly 250 cu. ft. per second, and of a 12-in. meter. There are on the line of the East Jersey Water Co., up to date, four such meters, two 48-in., one 36-in. and one 16-in. meter.*

Before the piece of main conduit pipe which immediately adjoins the intake gatehouse was set in place, an open wooden flume was built to convey the water from the gatehouse to the pipe already laid. A carefully constructed weir was set in this flume, and a series of experiments were made to determine the discharge of the Venturi meter set in the conduit; also of the gatehouse sluice-gates, under varying conditions of quantity and of head. These two sets of ratings were carried on simultaneously, as the same stream of water passed first the sluice-gates, then the weir, then the Venturi meter. The rating of the 48-in. Venturi meter made in 1891 agrees perfectly with the ratings of the 108-in., and of the 12-in. meter made in 1887.

Making of the Conduit.—The conduit is made of open hearth steel, bought to conform to the following specifications as to quality:

> Tensile specimen to be 8 ins. long and 1½ ins. wide between measuring points. Tensile strength to be between the limits of 55,000 and 67,000 lbs. per sq. in. Elastic limit to be not less than 30,000 lbs. per sq. in. For plates ⅜ in. thick and heavier, elongation to be not less than 25% longitudinally on the plate, 22% transversely on the plate. Plates thinner than ⅜ in., elongation to be not less than 22½% longitudinally, and 20% transversely on the plate.
>
> Bending specimen to be 6 ins. long and 1 in. wide,

(*About 70 of the wooden valve boxes and only a few masonry vaults were used on the line.—Ed.)

*See Eng. News, Dec. 24, 1887, for abstract of Mr. Herschel's firs paper; and for an illustrated description of the meter and the electrical recording apparatus see Eng. News, July 7, 1892. The latter description was presented before the New England Water-Works Association in June, 1892, by Mr. R. A. Robertson, Jr., C. E., and was published in the Journal of the Association for September, 1892. Mr. Robertson's paper referred to the meters on the line of the East Jersey Water Co., one of which was illustrated in Eng. News, for July 7, 1892.

and to be hammered down flat, when cold, without showing cracks.

Test to be made from 20% of the plates selected at random.

Steel to contain not more than 0.06% phosphorus, and 0.06% sulphur, and 0.6% manganese.

This high quality of metal was chosen so as to leave no doubt as to the expediency of punching the plates, instead of drilling, or of punching and reaming them. This selection of steel cost the water company $85,000, as Bessemer plates could have been bought for that much less; but no $85,000 spent on the works was probably better invested. Apart from the advantage of being able to punch the plates without injury to them, there has seemed to be no expected or unexpected strain to which the pipe has been subjected, that it has not been able, largely by virtue of the superior metal of which it was constructed, to withstand without injury.

This steel was from the works of Carnegie, Phipps & Co., and was shipped in plates from Homestead, Pa., to the pipe works at Paterson, in cars specially built for the purpose, by the Lehigh Valley Railroad Co.

Shop riveting was done by machines, using open hearth steel rivets, of a tensile strength between 57,000 and 63,000 lbs. per sq. in., and of an elastic limit of 30,000 lbs.

Field riveting was done by hand, using iron rivets of a tensile strength of 55,000 lbs., and an elastic limit of not less than 27,500 lbs.

Each length of pipe as shipped on railroad cars was made up of four plates, each plate 7 ft. wide, long enough to make one section of about 27 ft. of pipe, made up of two long sheets and two short ones. Various data with regard to such a length of pipe are given in the accompanying table.

General Dimensions, ins.				
Nominal size pipe	48	48	48	36
Thickness of sheets	¼	5/16	⅜	¼
Size of large sheets	154¾×84	155⅜×84	156 1/16×84	118¾×84
Size of small sheets	153⅛×84	153¼×84	153⅝×84	116⅞×84
Inside diameter of large ring	48	48	48	36½
Inside diameter of small ring	47½	47⅜	47¼	36
Size of rivets	⅝	¾	⅞	⅝
Size of rivet-hole	11/16	13/16	15/16	11/16
Circular Seams, ins.				
Number of rivets per seam	100	84	76	76
Circumference of large sheets	151.582	151.779	151.975	115.641
Circumference of small sheets	149.895	149.717	149.538	113.883
Rivet pitch, large ring	1.515	1.807	2.053	1.521
Rivet pitch, small ring	1.498	1.782	2.020	1.498
Distance from center rivet to edge plate	1	1 3/16	1⅜	1
Lap of sheets at circular seam	2	2⅜	2¾	2
Longitudinal Seams, ins.				
Number of rivets in first row	35	29	25	35
Number of rivets in second row	34	28	24	34
Rivet pitch, both rows	2.277	2.721	3.125	2.277
Distance between rows	1 1/16	1 3/16	1 5/16	1 1/16
Diagonal pitch	1.557	1.806	2.041	1.557
Distance pitch line to edge plate	15/16	1 5/32	1 11/32	15/16
Lap of sheets	3	3½	4	3

The California practice is to carry a portable punch, shears and bending rolls into the field, and make all bends needed to fit the ground, on the spot. On the work of the East Jersey Water Co. the engineer corps devised the plan of forming all bends by means of only four standard bevels, used in combination with the standard 28-ft. length of chord, or of straight pieces of pipe. This made curves of 2½, 5, 7½ and 10° curvature, and no other curves were used on the survey of the pipe line. Vertical curves, also, were made on 10° curvature. The whole pipe was laid out in the shop, to fit the ground as it had been surveyed; each piece was tagged with a tin tag and number, signifying where it belonged on the line, and was laid in the ditch at the points corresponding to its tin tag without further fitting or trimming.

The author being strongly of the opinion that to insure the preservation of any metal from rust it is necessary to coat the same before any rust has begun to form, great pains were taken to get the plates from the rolling-mill to the pipe shop in a clean and bright condition. Several plans for this were tried without success. One of them consisted in dipping the plates in paraffine at the rolling mill, and failed on account of the resultant difficulty in passing such coated plates through the bending rolls. The system finally adopted was to have 40 special cars for this "trade" alone, and to keep constantly passing the loaded cars to the shop, and the "empties" back to the rolling mill. These were new coal cars, with deep bodies, and with a specially constructed, removable flat roof, as a cover for the plates; made in two sections, and flat enough for brakemen to walk on. These roofs could be lifted off and put on by the same cranes that handled the plates. Both loading and unloading being done under cover, the plates, when everything was going well, were shipped, received, made into pipe, and dipped, before rust had a chance to show itself.

The dipping was done in iron vats built especially for the purpose, one length of pipe at a time. The material used to dip into was asphalt, from Southern California. Asphalt is found in Southern California in two forms: (1) Combined with 40 to 60% of sand, making rock asphalt; and (2) in liquid form, being combined with a species of petroleum. To use the first, it must be refined; that is, melted out of its combined sand, then remelted, and mixed with a certain proportion, usually of coal tar, to give it a proper consistency for having pipe dipped into it. The liquid asphalt, on the other hand, must be distilled until the bitumen remains as a residuum; and this, when remelted, is usually mixed to make it more fluid, or viscous, with the product of the same wells, taken at a lesser stage of distillation. The distilled asphalt used on these works was shown by repeated chemical analysis to be 98% pure bitumen.

The sheets, as received, were punched by gang punches, bevel-planed on the edges, rolled into cylinders, riveted by hydraulic riveters, calked with the pneumatic calker (by hand only in odd places), and twice dipped, as stated, in boiling asphalt.

(Fig. 14 shows the method of forming double-lap joints at changes in thickness of the plates forming the pipe. Two of the larger sheets were always used for these joints.—Ed.)

Four lengths of pipe, two lengths below, two on top, made a neat car-load, and one length at a time was a two-horse-wagon load on good roads, or a four-horse load up the mountains, which brings the pipe to the side of the ditch.

Laying the Pipe.—Pipe laying commenced Sept. 20, 1890, at the crossing under the Pequannock River. The contract for making and dipping the pipe, delivering it side of the ditch, and riveting it together in the ditch had been let Jan. 18, 1890, to Messrs. McKee & Wilson, boiler makers, then of South Bethlehem, Pa. The interval had been spent in getting a shop built at Paterson, N. J., riveters and other tools made and set up, and generally in getting the pipe works started. In the following April a contract was made by the water company with Messrs. T. A. & R. G. Gillespie, of Pittsburg, Pa., for digging the ditch and back-filling; the contractors for making the pipe contracting at the same time, with the same parties, for riveting the pipe together in the ditch. This was a much better arrangement, making, as it did, two consecutive pieces of work of the building of the conduit.

The settled method of laying pipe soon came to be to rivet two lengths together, beside the ditch, making a 54-ft. length; to lower these 54-ft. lengths into the ditch and connect them by bolts temporarily. Then rivet up; each circular joint being made, the lower half from the inside, the upper half from the outside. Cover the pipe as soon as possible with earth as a guard against undue expansion and contraction, taking care to tamp well up to a point either side of the pipe, which is somewhat above the horizontal diameter of the pipe. If need be, cover in this way before all the field joints are riveted, and leave uncovered only the joints yet to be riveted. Protect both inside and outside the pipe with old canvas, carpets, etc., in a careful manner, against abrasion of the asphalt, by the workmen walking on and in the pipe. Have riveters and others wear rubber boots. See that all abrasions of asphalt, caused in transport, are retouched before the pipe is lowered into the ditch.

For retouching pipe in this way extensive use was made of "P. & B." paint, which is merely asphalt dissolved in bisulphide of carbon, the bisulphide taking the place of the linseed oil of ordinary paint. After this paint is applied the bisulphide evaporates, and there is left a coating of practically pure bitumen. This paint did most excellent service throughout the work.

In June, 1891, 22,165 ft. of pipe were laid in the ditch, making the maximum month of pipelaying; though in May, June and July the average was 19,347 ft. Pipemaking never exceeded these rates of pipelaying, when work went on night and day, and usually was much less, because not so hurried. There was no such need of hurrying it from the fact that pipemaking could be carried on every day and all winter, while pipelaying had to stop in winter and in rainy weather. The work of the pipe shop represents that of three hydraulic riveters, and enough other machinery to keep them going.

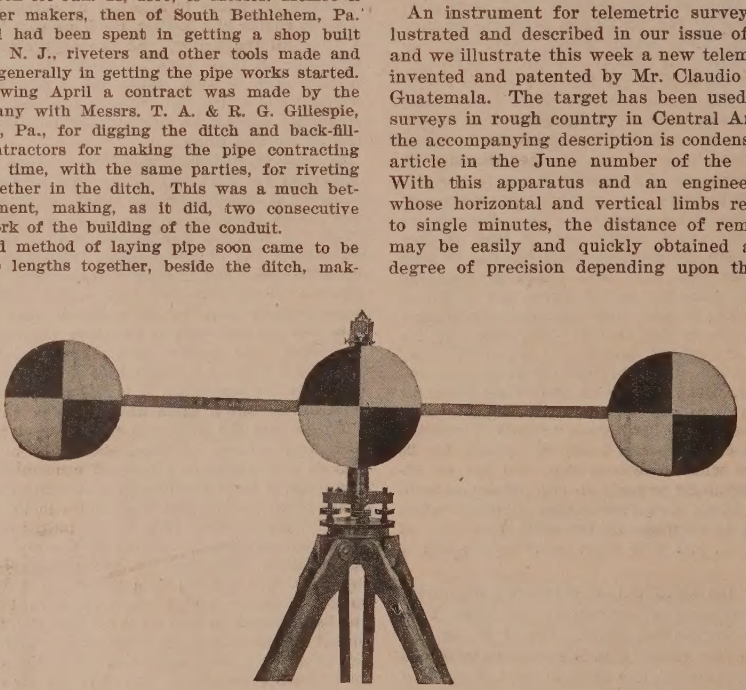
The water was first turned on at 8 a. m., Dec. 30, 1891, and the last manhole plate was screwed down at about 10 a. m. the same day, but at a point some eight miles from the intake gatehouse.

Before turning on the water the corps of inspectors of the pipe work in the field was directed to walk through the pipe, from end to end, in consecutive days' journeys. The 4-ft. pipe can be readily walked through, with a little stooping, but to walk through the 36-in. pipe the inspector must go on his hands and knees, at the same time carrying a lantern in his mouth, or set in his hat. The utility of the inspection was shown by the articles found.

The water first reached Belleville reservoir Jan. 12, 1892, having been allowed to fill the pipe by day only, and proceeding cautiously along the whole length. Also drawing off and remedying defects as they were developed. Feb. 15 the water first reached the South Orange Ave. reservoir, having been delayed to await the completion of the high-service gatehouse. The city of Newark has pumped no water for the consumption of either the low or the high-service districts since April 26, 1892.

A NEW TELEMETER TARGET.

An instrument for telemetric surveying was illustrated and described in our issue of March 23, and we illustrate this week a new telemeter target, invented and patented by Mr. Claudio Urrutia, of Guatemala. The target has been used on several surveys in rough country in Central America, and the accompanying description is condensed from an article in the June number of the "Compass." With this apparatus and an engineer's transit, whose horizontal and vertical limbs read at least to single minutes, the distance of remote objects may be easily and quickly obtained and with a degree of precision depending upon the accuracy and care of manipulation of the instruments used. This instrument enables the engineer working in mountainous districts to obtain both horizontal, vertical and inclined distances without having to encounter the tedium and the difficulties of chaining and with a greater degree of accuracy than with the gradienter or stadia.



NEW TELEMETER TARGET.

The apparatus consists of three disks or targets firmly attached to a horizontal bar, the distance between their vertical diameters being half a meter (1.6404 ft.). The center disk is connected with a vertical spindle capable of being revolved in a socket which is provided with leveling arms, screws and a tripod plate, this latter being screwed on a tripod head, as in the case of a level, and as shown in the figure. Two bubble tubes are provided by means of which the spindle can be made perfectly vertical, and the disk bar consequently horizontal, in any position in which it may be placed, while a sighting arrangement, seen over the center disk, enables the targets to be so adjusted that an imaginary line from the vertical diameter of the center disk to the observer's transit will be perpendicular to the bar. The exact spot whose distance is desired is determined by a plumb bob suspended in the usual way. For convenience in packing the two arms of the bar are jointed, allowing the three disks to be folded over each other.

The method of using this instrument is as follows: It is mounted in position by means of the plumb bob at the end of the line which is to be measured, carefully leveled and sighted to the other end of the line where the transit is placed, then clamped by means of a screw behind the center target. The observer at the transit then measures the horizontal angle subtended by the vertical diameters of the two outer targets, repeating the measurement until a total angle of at least 3° has been obtained. The total angle and the number of measurements being noted, the direct distance is calculated by means of the following formula:

$$\text{Distance in feet} = 1.6404 \times \cot \frac{m}{2\,n}.$$

m = total angle of all the measurements in minutes;

n = number of measurements taken;

Where the distance is required in meters instead of feet, substitute the constant 0.5 for 1.6404. As, however, half the mean subtended angle is not likely to exceed 50 minutes, seeing that this would give a direct distance of 1.6404 × 68.75008 = 112.778 ft., it may be assumed that the cotangent of an angle is inversely proportionate to the number of minutes in the angle, and the following formula may be used:

$$\text{Distance in feet} = 11{,}278.56 \times \frac{n}{m}.$$

The difference between this method and the use of correct cotangents is but 1-10-in. for a distance of 112 ft., which difference diminishes as the distance becomes greater, practically disappearing at 500 ft.

If the direct distance to the target is not horizontal, but inclined, then it must be reduced to the horizontal by multiplying the inclined distance by the cosine of the angle of elevation or depression of the target, as found on the vertical limb of the transit, so that we have:

$$\text{Horizontal distance in feet} = 11{,}278.56 \times \frac{n}{m} \times \cos a.$$

a = angle of elevation or depression of the transit telescope.

Should it be required to ascertain the vertical height from the horizontal plane passing through the transit telescope axis, we have:

$$\text{Vertical height in feet} = 11{,}278.56 \times \frac{n}{m} \times \sin a.$$

If the distances are required in meters substitute the constant 3,437.74 for 11,278.56. The center disk may be used in cases where obstacles prevent the sighting to be made on the two outer disks, care being then taken to divide the constants in the above formulas by two. This telemeter target has been submitted to many tests, and has been found to give very accurate results. It is manufactured and sold by the Keuffel & Esser Co., of New York.

HIGH SPEED ELECTRICAL LOCOMOTIVE.

The first electric locomotive of considerable size in the United States, and what bids fair to be the first practically operative high speed electric locomotive in the world, adapted to steam railway service, has recently been completed at the works of the General Electric Co., at Lynn, Mass., and will shortly be exhibited at the World's Columbian Exposition. The accompanying views will show its main features, and its completion seems to mark a distinct advance in electrical development. The locomotive weighs 30 tons and is designed for a normal speed of over 30 miles per hour. It is primarily intended for operation on elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, as will be seen, and runs on four 44-in. wheels. It goes without saying that every possible effort has been made to make it solid and substantial. Its main dimensions are 16 ft. 6 ins. long, 11 ft. 6 ins. high, 8 ft. 4 ins. broad, having its drawbars 2 ft. 6 ins. from top of rail, which is the Manhattan Elevated R. R. standard height. The drawbar pull is calculated at 12,000 lbs., we are informed, though this estimate, of course, is the maximum for slow speed.

The propelling power is furnished by two electric motors shown in part in Fig. 3, each axle being provided with one motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension is adopted to leave the wheels free to adjust themselves to the irregularities of the roadbed, and consequently to reduce the wear of both tracks and motors.

The motor fields consist of massive iron castings to which the hollow field spools are bolted. The armatures are of the ironclad type, having each separate winding imbedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which allow of freedom of motion in all directions. The commutators are of massive construction and there are four sets of brushes to each commutator.

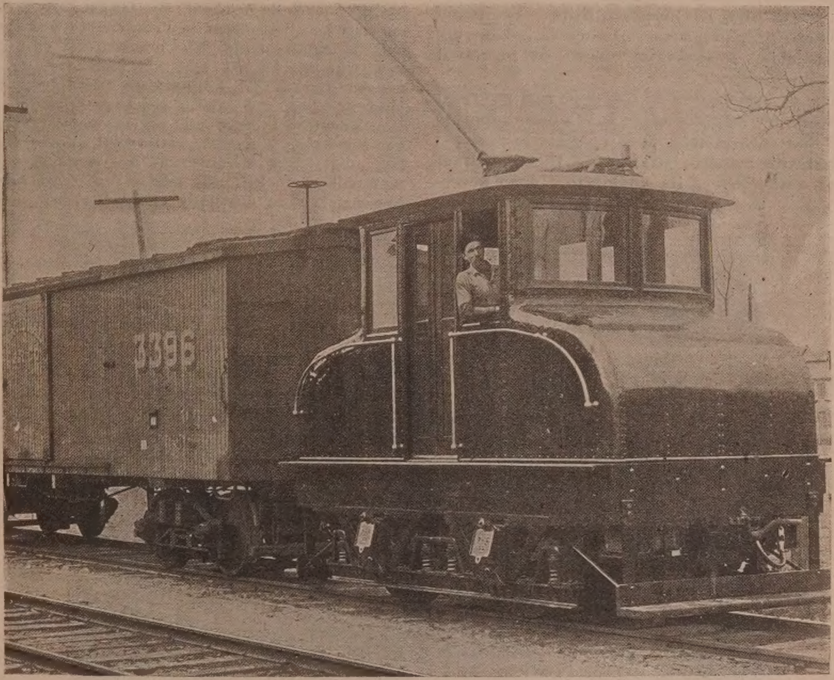


FIG. 1. HIGH SPEED ELECTRIC LOCOMOTIVE; GENERAL ELECTRIC CO.

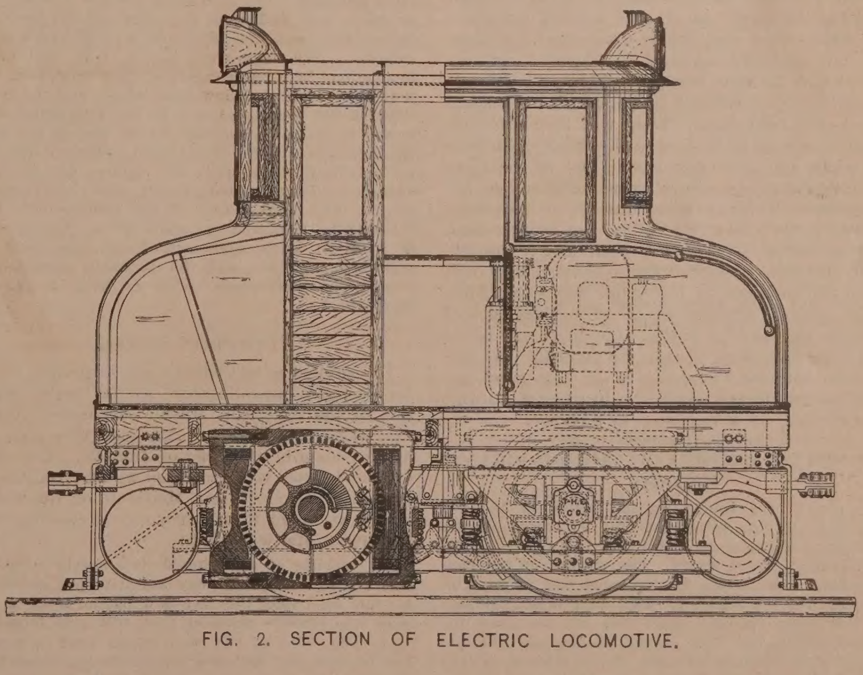


FIG. 2. SECTION OF ELECTRIC LOCOMOTIVE.

The motors are controlled by means of a series parallel controller, set up in the interior of the cab, and embodying all the latest improvements made in this type of apparatus by the General Electric Co. The tests have indicated that the series parallel controller allows of a more gradual and easier starting of the electric motor, and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy I-beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and curved off to diminish the atmospheric resistance, as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motorman's movements, and it affords him considerably better protection than is usually vouchsafed to the steam locomotive engineer. The position of the headlights is shown in Fig. 2.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump has an oscillating cylinder of 6 ins. diameter, with a 6-in. stroke, supplying 6,000 cu. ins. of air per minute at 70 lbs. pressure. The motor is similar to the N. W. P. 2½ in general appearance, but is wound for a higher speed. The normal speed of the armature shaft is 675 revs., and of the crankshaft of the pump 110 revs. The dimensions of the air compressor are: Length, 41 ins.; width, 16½ ins.; height, 23 ins. The pump motor is controlled by a special rheostat. This, by an intermediary device, is automatically regulated by the air pressure.

The use of locomotives of this type and proposed speed over very long distances is at present limited only by the cost of long lines of electric feeders; and until the problem offered by this condition is solved, restriction of its employment must necessarily exist. But for places comparatively near each other and where traffic is dense (the denser the better) the electric locomotive seems to be peculiarly adapted, for here all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

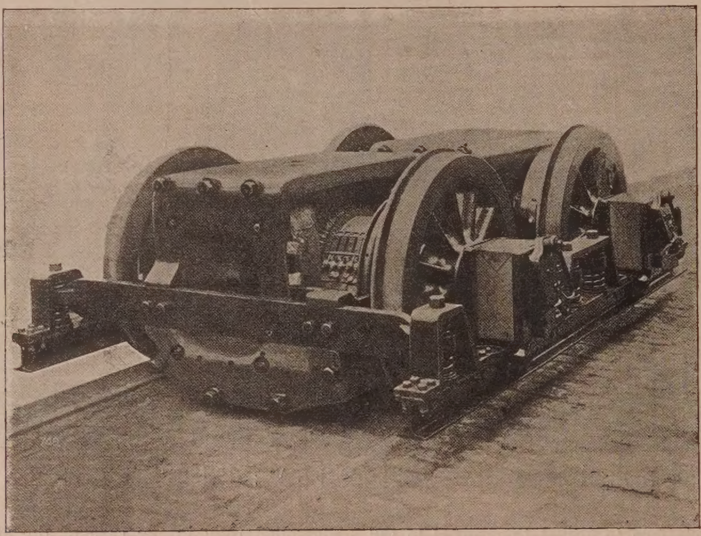


FIG. 3. MOTOR TRUCK OF ELECTRIC LOCOMOTIVE.

The evolution of the use of the electric locomotive will probably follow along the lines outlined, extending gradually out to the as yet uncertain point where they cease to be economical. At first they will probably be used in elevated railway service; and in New York, Brooklyn and Chicago at least, their advent will be hailed with a general feeling of thankfulness. They will then probably extend to service as feeders to the trunk lines, both for freight and passenger traffic, and to operating short suburban lines, where a rapid, efficient service is requisite. Their peculiar fitness for switching purposes is likely to advance their use another step, and then slowly, let us hope, when and if the different problems presented are overcome, they will invade the province of the trunk line steam locomotive, and the millennium of railway travel will be within the realities of life. For there can be no sort of question that, if only the financial and mechanical obstacles to its use which now exist can be overcome, electric propulsion in general railway service would be a vast step in advance.

TEN YEARS' RECORD OF THE BROOKLYN BRIDGE.

The use of the bridge by the public in the ten years since it was opened has far surpassed all the calculations of engineers and others in advance of the completion of the structure. The wisdom of the men who widened the bridge so that room was afforded on the roadways for teams to pass each other, so that one slowly-moving load could not set the pace for all the traffic, has been amply vindicated, and the policy which raised the height of the trusses so that cars of standard size could be used instead of the squatty ones it was at first proposed to use, has also been shown to be wise, and will be still further approved when electric elevated cars are run over the bridge from the elevated roads at either end without change. The grip in use upon the bridge cars, invented by one of the engineers, has been shown by the success attending its constant employment to be admirably adapted for the use to which it is put, the "life" of a cable being much more protracted than if the grip used with ordinary cable cars were employed. The system of switching cars has proved successful for a far greater traffic than was ever expected it would be called upon to handle, and by the improvements soon to be made with new platforms and tracks on both sides of them, the facilities for travel will be doubled, and twice as many passengers can be carried.

In the ten years the receipts of the bridge from all sources have been about $10,000,000. Of this about one-half has been spent in maintenance and the other half in improvements. The original cost of the structure was $15,000,000, and the total cost up to the present time about $20,000,000. There have been a total of about 280,000,000 passengers carried in the cars since the railroad was put in operation, the number increasing from 8,000,000 in 1884 to over 40,000,000 last year. The car-fare was five cents at first, but was reduced to half this sum a few years ago. Foot passengers were originally charged a cent, and later one-fifth of a cent, but in 1891 the promenade was made free. Before that time about 3,000,000 people walked over the structure each year, and it is supposed that the number has been greater since, although no record can be kept, making a total of about 40,000,000 who have walked across the bridge. The earnings of the roadway from tolls, now only one-half of what they formerly were, are about $80,000 a year. From car-fares over $1,250,000 was received last year. The bridge was begun in 1870, and was 13 years in construction. The towers are 278 ft. high, and rest on foundations built upon caissons. The New York tower foundation is 78 ft. below high water, and the foundations of the Brooklyn tower 45 ft. The center of the bridge is 135 ft. above high water, and at the towers the height is 110 ft. The cables contain 5,296 wires, each 3,578 ft. long, and the cables are 16 ins. in diameter. They uphold 14,680 tons of permanent weight. The total length of the bridge, with extensions, is 6,537 ft., and the width 85 ft. The river-span is 1,596 ft., each land-span 930 ft., the New York approach 1,562 ft., and the Brooklyn approach 971, making the carriage-way 5,989 ft. long.—N. Y. "Evening Post."

FIREBOX STEEL.

The subject of the quality and inspection of steel for fireboxes was discussed at the recent convention of the American Master Mechanics' Association (Eng. News, June 22), and was also commented upon in our issue of June 29. The following brief paper was presented by Mr. William McIntosh, Division Master Mechanic of the Chicago & Northwestern R. R., at a recent meeting of the Northwest Railway Club:

The expense of renewing firebox sheets is so great that railway companies can afford to pay much more for this steel than they are now paying if by so doing they can procure material that will give longer service. The value of the steel sheets used in repairing and constructing fireboxes represents but a small part of the cost of such repairs and renewals. I estimate not more than 10%. On the one hand we have the cost of material, and on the other we have the labor that is required in this work, the expense of tearing down machinery that otherwise would not have to be disturbed, and the loss of service of the engine, which, for the time required to put in a new firebox, would average not less than six weeks or 45 days and amount to $360, on a conservative estimate of $8 per day as the value of such service. This item alone aggregates several times the value of the steel needed for the new box. It is therefore obvious that if it were possible to procure a better quality of steel, even at double the price we are now paying, which would render one-half longer service, it would be wisdom to get it. This does not admit of discussion.

The questions now arise Where are we going to obtain this good steel, is it in the market, can it be manufactured? My knowledge of the manufacture is limited, and I will not undertake to do more than say that I think such a quality of steel can be procured at the figures now quoted, or even at a less cost. The quality of firebox steel has either deteriorated during the past ten years, or the conditions of service have so radically changed that it is destroyed much quicker. I draw these conclusions from observations during that period; and as an illustration I will say that I have taken out fireboxes within the past few years that had been in service from eight to ten years, and I have recently removed fireboxes that have been in service but four years. I have also renewed sheets that were in service but one year. The firebox that gave ten years service was crucible steel, and the sheets that lasted but one year were from the open-hearth furnace. Whether the latter process allows the raw material of an inferior quality to be introduced I am not prepared to say positively, but I think it does. That only the best of material is used in the former process goes without question. Whether the open-hearth process can produce a better quality of steel by taking the same quality of metal to commence with that the crucible method uses, is a question that steel makers can best determine. The subject is one well worth investigating, as there is a wide margin of economy outlined in this proposition. Complaints are general throughout the Western country about the unsatisfactory service obained from firebox sheets, and it is my opinion that if some enterprising manufacturer produces a superior quality of steel he will find plenty of purchasers for it.

ROPE POWER TRANSMISSION.*

By Jas. M. Dodge, M. Am. Soc. M. E.

Rope-power transmission is comparatively a development of recent times. Although ropes were used in isolated cases for this purpose many years ago, it may be said, so far as this country is concerned, that the last 10 years have seen the adoption of rope-power transmissions become more general and the system take a recognized place in the field of mechanical engineering.

There are two general systems in vogue, which may be designated as the "English" and the "American." The former employs one or more single ropes, whereas the latter uses one continuous rope and employs a tension carriage, operating on one of the turns of the rope, to insure a uniform amount of work being performed by each wrap around the wheels.

Wheels, or sheaves, used in connection with the rope for the purpose of transmitting power, are made with V-shaped grooves in the rims, the most commonly accepted angle being 45°. These grooves are made sufficiently deep to prevent the rope bottoming, or resting upon the bottom of the groove, the object of this being to increase the resistance to slipping and enable a moderate weight on the tension carriage to give sufficient driving force.

Sheaves used in conjunction with manilla rope are made in two ways, the older method being to cast the sheaves with sufficient width of face for the number of grooves desired and to roughly core the grooves, so as to lessen the amount of iron to be removed by the turning tool in finishing them. It is necessary to cast the wheels sufficiently heavy to resist the pressure of the turning tool, in order to have the finished wheels as round as possible. It is almost impossible, however, to avoid a small amount of spring between the arms, so that upon careful measurement the wheel is found to be polygonal. This is notably the case when the cut is heavy, it being necessary, in order to obtain a good result, to take a roughing cut, which releases the skin tension of the casting and permits it to take a modified shape, due to the internal strains ever present in cast iron wheels designed to have the outer surface removed from them by turning. Then a second cut is taken, and finally a finishing cut is made with a tool ground to the exact shape of one of the finished grooves, this last cut, which is made more to true up the inequalities of the previous work, removing but very little metal. In the foundry work connected with the manufacture of these wheels, it is seldom that a wheel having two or more grooves in it is so perfect that upon turning imperfections are not discovered. These, of course, if too numerous, render the condemnation of the casting necessary. If, however, the sandholes, or blowholes, in the turned surface of the sheave, are not too large, they are filled with babbitt metal, and the sheaves are put in use. The amount of metal turned from castings for rope sheaves is astonishingly large; for instance, in the case of a five-groove sheave of 48 ins. diameter, for 1⅛-in. rope, the rough weight before turning was 698 lbs., and after finishing the weight was 567 lbs., showing that 131 lbs. had been turned off the original casting. This proportion would, of course, vary somewhat, dependent upon the care taken in the foundry, but at the same time it is always greater than would be supposed.

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*A lecture delivered before the Franklin Institute of Philadelphia.

The second and newer method of manufacturing sheaves is that practiced by the "Link-belt" companies and differs from the already described method in two very important features. In the first place, the sheaves are not turned after being cast, great care being taken in the proportioning of the hubs, arms and rims, so that the castings can be made of extreme lightness, but being devoid of internal strain are very strong. The grooves are cast on green sand cores, a three-part flask being used. By this we mean the flask has a cope and a drag, as is common in all foundry work, but between them is placed what is known as the "third part," or "cheek piece," which holds the sand destined to form the grooves in the finished wheel. It has been found in practice that it is possible to cast sheaves in this manner that are fully as accurate as turned ones, and with an average saving in weight of 17.2%, this saving in weight, of course, effecting a corresponding economy in the power required to operate a rope drive furnished with them.

The second radical difference between the "Link-belt" sheaves and the solid turned sheaves is, that the manufacture of multiple groove sheaves, or those having more than one groove, is effected by bolting together what are known as arm sections (which are really complete sheaves of one groove) and rim sections (which are simply grooved rims cast without arms or hubs). This plan makes it possible to vary the weight and strength of multiple groove sheaves by using a greater or less number of arm sections, dependent upon the size of the rope to be used and the varying conditions of their employment. After the sheaves are "built up," as it is termed, they are bored out, and to show the trifling difference in weight between the rough and finished sheaves, I would state that a 48-in. five-groove sheave for 1⅛-in. rope weighs in the rough 433 lbs., and when finished 423 lbs., or 144 lbs. less than the finished solid-turned sheave referred to previously.

So great is the care taken in the casting of "built-up" sheaves, that the only finishing required in the grooves is that of smoothing the casting by holding a block of emery in the groove while revolving at a speed of about 120 revs. per minute, the finishing of each groove in this way not occupying more than three or four minutes.

An incidental advantage of the multiple groove "built-up" sheave is, that after a rope drive is erected and the necessity arises for the transmission or more power than that for which it was originally designed, additional ring section may be added to the sheaves, and by splicing in an additional piece of rope, the desired increased transmitting capacity may be secured.

It is obvious that in the use of a single rope making a number of wraps around two wheels, it is essential that the diameters of the grooves at the pitch line, which is the arc of contact of the ropes, must be uniform in all of the grooves in any one sheave; otherwise, there would be a tendency on the part of some of the wraps of the rope to travel faster than the others, which tendency must be counteracted by the slipping of the rope in some of the grooves, this, of course, resulting in a loss of power and also in the rapid wear of the rope. So important is this feature, that great care has to be taken in splicing the rope, so that the diameter at the splice will be no larger than in the body of the rope. An increased diameter at the splice would, of course, make the splice travel around a larger circle on the sheave by its not being able to take as low a position in the V-shaped grooves.

It is impossible to splice a rope without impairing its strength at the splice, provided its diameter is not increased. What is ordinarily known as the "short splice," or the "long splice," as used by sailors, will not answer at all. It is essential that a splice (for instance, in a rope 1 in. in diameter) should be from 10 ft. to 12 ft. long, and made with great care, so that after the splice is complete the tension to which the rope is subjected is evenly divided among the strands of the rope.

Durability of manilla rope transmissions is dependent upon various conditions, the most important one probably being the quality of the rope. In order to make good rope it is necessary that the fibers employed in its manufacture should be long and of nearly uniform size. The fact that the fibers of manilla have a rough interior and are of great strength in proportion to their weight, is an important factor in the strength of the rope when subjected to a tensile strain, but at the same time this very roughness becomes an element of destruction when the ropes are passing around sheaves which cause the fibers to slide upon each other, so that the internal wear of a rope becomes a most serious agent in destroying it. A worn-out rope untwisted so as to expose the strands will show a fine powder which has been chafed off the fibers. Of course, after this has been detached from the fibers, it leaves them weaker than in their original condition. It is also noticeable that the fibers of manilla, being composed of elongated cells, are not perfectly adapted to continued bending.

In order to counteract the destructive tendencies enumerated, it is essential that the rope should be lubricated. This is accomplished in two ways, the first being by the introduction of a lubricant in the manufacture of rope; notably, as in the case of what is known as the "stevedore," into which tallow and graphite are introduced at the time the rope is made, the effect being to increase the flexibility of the rope, increase its life and to render it to a degree waterproof, and also in the ropes of some other makes, which are laid with tallow. The second method is to coat the outside of the rope with a mixture of lampblack or graphite and grease, relying upon the working of the strands of the rope with relation to each other to work the compound through it. This latter method is practiced on the Continent, and is also being made use of in this country to a considerable extent.

Some of the larger constructors of rope transmissions in England claim that manilla rope should never be used under any circumstances; that cotton is the only fiber that will give satisfactory results. I have seen samples of a rope 1⅜ ins. in diameter, which had been in constant use 10 hours a day for nearly 16 years. This was a cotton rope, known as the "Lambeth," the peculiarity of its construction being that it was primarily made of cotton, but each of the four strands of the rope was covered with a number of tightly twisted yarns, forming a protecting envelope, which prevented cutting or wearing of any of the strands proper of the rope. Of course, cotton ropes are much more expensive than manilla ones, and a rope such as the "Lambeth" must necessarily be the most expensive of those made of cotton.

It is unquestionably true, that in time cotton ropes will be more extensively used in this country, crowding out the use of manilla; but it is a fact that the introduction of any radical departures in the field of mechanical engineering are only possible by offering not only a more satisfactory article than has formerly been used, but also a cheaper one. This fact has aided in the introduction of the manilla rope drive, as in many cases it is not only the best means of transmitting power, but also the cheapest. Ultimately, and as users of rope drives become more familiar with their intrinsic advantages, they will be more ready to increase the original outlay and put in the best rope that can be made.

If manilla rope transmissions are designed with good judgment and are properly erected, there is no possible doubt of their giving satisfactory results. The prevailing notion is, however, that as rope is flexible in all directions, rope drives can be constructed in a haphazard manner, without special care being exercised in getting the sheaves in exact alinement, and considerable criticism has been engendered by lack of attention to the important details. When borne in mind that a rope used for the transmission of power runs at a speed as high as 5,000 ft. per minute in many cases, and as a rule the rope is run in close proximity to the ceiling, which is the hottest part of a room, it is not surprising that the rope rapidly becomes dry and correspondingly brittle; hence the importance of lubricating it in some way, to counteract the drying tendency. It is not uncommon to find rope transmissions erected so that the sway of the rope will occasionally bring it in contact with a beam, which, of course, results in extremely rapid wear of the outside of the rope. The fact that conditions of this kind exist is sometimes hard to discover, as when the rope is at rest it may apparently have abundant clearance throughout the path of its travel. One case brought to my attention, in which the rope was being rapidly worn out, resulted in the discovery of the fact that in its passage through the wall of a building, the rope would sway and come in contact with the edge of a corrugated iron covering of the building. On calling this condition of affairs to the attention of the parties operating the drive they seemed quite surprised that such a trifling thing as an occasional touching of the rope on the corrugated iron should in any way impair the life and usefulness of the rope.

Manilla rope is usually run under a working strain equal to 3% of its ultimate breaking strain and at velocities varying from 3,000 to 5,000 ft. per minute.

To determine the power which any rope will transmit at a given speed, it is necessary to ascertain the nature and amount of the strains to which it is subjected while running, and then to find the exact part of the total working strain which is expended in performing useful work.

Generally speaking, ropes in the "American" system are subjected to three principal strains, viz., the strain due to the power transmitted; that due to centrifugal force; and that due to the tension carriage weight. Besides these three there are the minor strains, due to the weight of the rope, the internal resistance of the rope to bending and the strains required to make the rope enter and leave the wedge-shaped grooves. With good ropes, running in well-made grooves, the minor strains do not probably absorb more than 5% of the working strain of the rope.

As an illustration of the method of determining the horse-power of a rope in the American system, let us assume the case of a 1-in. rope traveling at a speed of 4,500 ft. per minute. The breaking strain of this rope, as given by the Plymouth Cordage Co., is 9,000 lbs., and according to the limitation imposed by good practice, the total working strain should not exceed 3% of this, or 270 lbs. Deducting 5% for the minor strains, we have 257 lbs., which represents the sum of the three principal forces.

In order to obtain the effective strain, or driving force, it is first necessary to find the strain due to centrifugal force. This force varies directly as the square of the speed, and may be found by multiplying the square of the speed in feet per second by the weight of 1 ft. of rope, and dividing the product by 32.

Now, the weight of 1-in. manilla rope per foot is 0.33 lbs., and the centrifugal force, therefore, equals:

$$\frac{75^2 \times .33}{32} \text{ or about 56 lbs.}$$

Substracting this from 257 lbs. we have 201 lbs. as the sum of the strain due to the power transmitted and the strain due to the tension carriage weight.

New a series of carefully conducted tests have established the fact that a weight of (say) 50 lbs. on one end of a rope wrapped halfway round a sheave having a 45° V-groove, will sustain, without slippage, about 3½ times its weight at the other end of the rope. Assuming, for the sake of safety, that this ratio is as 1 : 3; it is evident, that to sustain a strain of 201 lbs. on the tight side without slippage, it is necessary to maintain a tension of ⅓ this amount, or 67 lbs. on the slack side. The effective strain, or driving force, will, therefore be equal to the difference of these strains, or 134 lbs., which, at 4,500 ft. per minute, will transmit

$$\frac{4,500 \times 134}{33,000} \text{ or 18.4 HP.}$$

In the same manner we find, that at a speed of 1,800 ft. per minute, the centrifugal force is only 9 lbs., and the effective strain is 166 lbs., transmitting 9 HP.; while at a speed of 6,600 ft. per minute, the centrifugal force is 125 lbs. and the driving force only 88 lbs., transmitting 17.6 HP.

On reflection it is evident, that as the speeds are increased the centrifugal force increases, and the effective tension must be reduced to avoid overstraining the ropes. At a speed of about 4,800 ft. per minute the ropes attain their greatest efficiency; that is, they will transmit more power with the assumed working strain than at any other speed, either higher or lower, although there is but little variation in the power transmitted at that speed and the power transmitted at either 4,200 ft. per minute, or 5,400 ft. per minute, thus giving a wide range from which to choose. It is well to bear in mind, however, that the higher the speed the greater the wear of the rope, and that for this reason the slower speed is the more economical. All things considered, speeds of from 3,600 to 4,200 ft. per minute are best.

It may be well to note that for the working strain assumed, 3% of the ultimate breaking strain, 40 diameters, should be regarded as the minimum size of sheaves to be used. If it is necessary to use sheaves of smaller diameter, the working strain should be proportionately reduced. Thus, in the case previously considered, a 1-in. rope at a speed of 4,500 ft. per minute transmitted 18.4 HP.; now if it is desired to use a 30-in. wheel as a driver, it is advisable to reduce the power transmitted to three-quarters of 18.4, or 13.8 HP. This rule does not apply to the driving and driven wheels, but also to any intermediate idlers around which the rope may be called upon to bend.

The idlers of rope transmissions have usually been made with semi-circular grooves, permitting the ropes to rest upon the bottoms of them. It has been found better, however, in practice to use the V-shaped groove for all purposes, as it insures a revolution of the idlers at the same speed at which the rope is traveling, and thus prevents the wear due to the slipping of the rope in the grooves of the wheel. It has been shown that idlers having semi-circular grooves in them become highly polished, while those having V-shaped grooves do not. Thus the demonstration that the ropes slip to a certain extent in passing over idlers with the semi-circular grooves is complete.

The use of the tension carriage in the "American" system of rope transmissions is twofold. In the first place where a continuous rope is used passing over the grooves of two sheaves, it is obvious that the rope must be wound spirally around the two wheels, and that unless the rope in passing off the last groove of one of the wheels is not conducted back again to the first groove of the wheel the drive would become inoperative, from the fact that all of the wraps of the rope would soon run off and leave the wheels without connection between them. In order to make this return, the wheel of the tension carriage is set at an angle so as to enable it to make the proper return of the rope. Secondly, the tension carriage is weighted so as to give the proper tension to the rope and serve as a corrective agent to the trifling inequalities that may exist in the sheaves or in the rope. It is by the weighting of the tension carriage that we are enabled to tell the exact amount of strain to which we are subjecting a rope. I might add that, the tension carriage being mounted on guides, it is capable of maintaining the proper tension of the rope, even if the latter becomes considerably elongated by the strain put upon it, or is variable in its length due to atmospheric changes. This latter is especially noticeable in rope transmissions which are used wholly, or in part, out of doors, they being subjected to the action of rainy and dry weather.

The use of wire rope for the transmission of power I will only briefly touch upon, by stating that the economic use of it seems to be confined to transmissions of great length. The sheaves employed have to be of very large diameter, otherwise the rope becomes crystallized and is of short life.

With reference to rawhide I might say that its cost has prevented its general adoption, as it is cheaper to use an increased number of strands of manila rope to accomplish the desired result, though it has one marked advantage, inasmuch as it is possible to use it on sheaves of smaller relative diameter than in cases where manila rope is employed.

If possible, in running the rope care should be taken to have the bends all in one direction, as a rope bent in opposite directions will wear with much greater rapidity.

WORLD'S COLUMBIAN EXPOSITION.—XVII.

The Grounds and Buildings.

The immensity and the architectural grandeur of the World's Fair buildings have been described so often, and most visitors have had their expectations raised to so high a point and have so clearly in their mind the unprecedented size of the grounds and buildings as one of the most notable features, that probably the first impression of many will be a certain feeling of disappointment when they first see the buildings; or if not that (for it hardly seems as if any rational being could be disappointed in them) of surprise. The buildings do not look large, and it is hard to convince oneself that they are very large. They look simply well proportioned and handsome; and this result, which is really perhaps the greatest triumph of design in the whole Exposition, and will be recognized as such by every discerning visitor who studies the matter, will inevitably produce a certain shock of surprise at the first glance.

Most visitors, for example, will have seen the capitol at Washington. They will remember its imposing massiveness of effect, and possibly remember also that it covers only 3½ acres. It looks at the first glance much larger than the Liberal Arts Building, covering 30½ acres. Many visitors will remember also the impressive effect of the vast Milan cathedral, covering less than three acres. Reading that the six great buildings which form the principal group around the Grand Basin alone cover some 80 acres of ground, 30½ of which is under a single roof (to go no further in statistics), and knowing that the buildings are also very high, the visitor expects to be at least as much appalled and impressed by the size of the buildings as he has been by the smaller buildings mentioned, and it belittles his first impressions to find that they produce vastly less instead of more effect of size than either of the buildings mentioned, or than most very large buildings.

The reason for this amazing result is the entire absence from the grounds of any familiar scale of comparison. Everything alike is on a grand scale, and harmoniously so. All the other great buildings of the world—even those of the former expositions—are or were closely surrounded by small (i. e., ordinary) buildings, which the eye unconsciously adopts as a scale; and by that scale estimates and appreciates the size of the greater building. At Philadelphia, for example, the buildings were a hodgepodge of small and great together. At Chicago this has been carefully avoided, and with consummate skill. All the great buildings were planned together on the same gigantic scale, with the express end of making them seem symmetrical rather than immense. All sharp contrasts of size have been carefully avoided throughout the grounds, so that there is everywhere, from any given point of view, an approximate similarity of proportions, not only in the Grand Court, but in the many minor groups.

The result is, perhaps, the most perfect optical illusion on a large scale which the world has ever seen. It is so perfect that it is lost upon the multitude, which accepts the evidence of its eyesight without question; and even the critical discussions of the buildings and grounds have only casually alluded to this particular feature. But it is alone worth a journey to Chicago to see, and one of the things best worth studying in the entire Exposition.

For example, standing in front of the Administration Building (a plan of the grounds will be found in our issues of Jan. 16 and Oct. 13, 1892) it is a good 1,800 ft. in the clear across the Grand Basin to the Peristyle. It looks about 600 or 700 ft., and the most expert judge of distances, forewarned of the illusion, will not place it at more than 1,000 to 1,300 ft. without violating his own real judgment. So we might mention a dozen other points of view where the same illusive effect is produced, the best anti-illustration on a large scale being the Art Building. This is really the smallest of the great buildings, covering only 4.8 acres, against 5.5 acres each in the Mining and Electricity buildings. But the Art Building fronts (or backs) on a row of state buildings, and although this row includes the largest and stateliest of them all, yet they give something like a natural scale by which the true size of the Art Building may be gaged. As a consequence, the immense size of the Art Building, as well as its dignity and beauty, is one of the sharpest impressions which the visitor receives on his first stroll through the grounds.

It is true that the apparent extent of the Art Building, when viewed from the land side, is increased by the fact that it has two wing annexes connected to the main building by long corridors, so that the entire extent of its front is over 1,000 ft. But then, the front of the Liberal Arts Building is some 1,700 ft., and so far as mere impressions go, the front of the Art Building will seem the longer to almost every visitor.

In one way only, that we were able to discover, can a true scale of proportions be obtained in looking at any of the main buildings, so that the eye can measure truthfully their immense proportions. At each end of the lake front of the largest of them all, the Liberal Arts Building, there is a chocolate pavilion, where cups of chocolate with appropriate biscuit are dispensed at five cents each —about the only cheap and good refreshments to be had on the grounds, for the restaurants are the only weak feature of the Fair, and a terribly weak one. The pavilion at the south end, where Baker's chocolate is dispensed, confesses itself architecturally to be a mere pavilion adjunct to the adjacent buildings, and so gives no scale, though of relatively trifling size. That at the north end, where Van Houten's Dutch cocoa is dispensed, is of a different character. It has no architectural relation to any of the buildings around it, but is an imitation in the Dutch style, and in excellent taste, of many red brick buildings to be found in Amsterdam.

The reader in search of a new and sharp impression should first visit this building and familiarize himself with its actual proportions at close quarters, inside and out. It deserves a visit for another cause, that it is the only restaurant building or room in the entire grounds which is luxuriously or tastefully fitted up, or indeed, in which appearance seems to have been regarded as of any importance. The building will be found to be of good size, four good stories high to the roof, with three stories more in the tower. On the streets of Amsterdam, or any other city, it would be rather a large building.

Let the visitor then (and not till then) walk down to the north entrance basin, near the brick man-of-war, and take passage in one of the little steam launches which give excursions into the lake along the Exposition front for 25 cts. When fairly opposite the Liberal Arts frontage let him then look at the Van Houten cocoa house. It is an amazing sight. The four-story building nestles under a corner of the eaves of its great neighbor like a child's toy house made of a block of wood, and suggests that at once. It is true that the immediate optical effect is to dwarf the cocoa house rather than to magnify its neighbor; but if the true dimensions of the former are already in the mind, it gives a realizing sense of the magnitude of the great buildings such as can be had nowhere else.

Another cause which helps to disguise the immense size of the buildings, and to leave them only things of beauty, is that there are no great spaces of mere greensward about the grounds. The buildings are nowhere crowded, but they succeed each other quickly. There are nowhere any such discouraging distances to be crossed in getting from one building to another as there were at Philadelphia, for example, as every visitor to Philadelphia must remember. Their effect (as also the long interior vistas, which have been carefully avoided at Chicago) was both to enhance the apparent size of the buildings and to enhance the sense of weariness, by making every visitor conscious of how much walking he was doing or had to do. At Chicago it has been recognized throughout that the first necessity was to diminish the effect of mere bigness, and cheat the visitor into the illusion that it is not very far from one place to another, and that the buildings are merely generous and handsome, not huge.

Never, surely, was such an end more perfectly secured. Every main building, even the hugest of all, produces this effect of having been designed solely with a view to stately dignity and grace. There is not one which one could wish smaller or larger. For a grand effect alone the proportions should be grand. The impression is that the several architects increased proportions without regard to expense so long as was necessary for this end, and then stopped—at dimensions which the eye takes to be about half of the truth!

The happy thought of using interior lagoons so freely is also a great factor in this last result. Water is not only a necessity to any finished landscape, but is also a great diminisher of distance. Now, the only long vista on the grounds is exclusively over water, and nowhere on the grounds can any but short vistas be obtained in which water is not a leading factor. This is, perhaps, the chief reason why the grounds seem small and manageable, as well as the buildings. Although the real areas are several times greater than those of any former exposition (the grounds include over 1,000 acres), the apparent areas and distances are less than at most of them.

It goes without saying that these results could never be attained by accident nor without both study and genius. It would have been quite impossible for the architects of the several buildings to have obtained the effect independently; the grouping and disposition of the whole has been the main factor, in connection with the prior agreement on certain common canons of proportion for all the main buildings. It would probably be unjust to ascribe all the credit for this unity of effect to any one man. Much that is good in the general effect was due to Mr. Root, whose untimely death was a great blow to the artistic prospects of the Fair, though fortunately it did not blight them. But the main credit for the laying out of the grounds and the general grouping of the buildings belongs by general admission to Mr. Fred. Law Olmsted, the creator of Central Park; and which is the greater triumph may well be questioned. In each work alike the highest art is to conceal art, and hence the mere sightseer will never award the credit which he should for either work; but whoever makes a study of either work must feel his admiration rise the higher because it is only by the study of details that he can find out how much of the grand effect is really due to this mere grouping of structures and accessories.

Popularly, the chief credit is ascribed to the architects of the several buildings which are so conspicuously in evidence, and it would be hard to exaggerate the credit which is due to them, individually and collectively. But if a vote of the architects themselves could be taken, we have no doubt each of them would say that the chief glory of his building was its setting, and that without it each would have been robbed of half of its effect. For that setting Mr. Olmsted is chiefly responsible, though many minds must have contributed important suggestions.

In laying out the grounds and buildings it has been important, and the same skill has been effective, to prevent belittling the small buildings as well as to make the great ones manageable; and also to reduce to a minimum the walking to be done by the average visitor to see what he might wish to. Thus the Forestry, Dairy and Anthropology buildings are interesting to relatively few and are also comparatively small. They are set off along the lake front at the extreme south, with a number of other buildings of that character, where they are neither dwarfed nor inaccessible, and where no one is compelled to walk past them who does not care for them. The reproduction of the convent of La Rabida is naturally still smaller, and is also filled with priceless relics. Yet, as a leading feature, it ought to be more in evidence, and sufficiently accessible, without drawing a crowd by mere propinquity. It is made so by placing it just off the main court yet surrounding it on three sides by water, by which it is completely cut off to all but sight except by walking some distance to a bridge. The effect is quite charming. The building is not dwarfed, but set off by the larger ones across the water, and the crowd with no set purpose to visit it is kept away from it.

On the other hand, the vast Liberal Arts Building can at no point on the grounds be seen in its full proportions except much foreshortened on the lake front. Otherwise, it is either seen end-on only or else with half its length cut off by the overlapping of the Electricity and Mining buildings. We say "half," but it is just short of half, so as to enable the great central portal of the Liberal Arts Building to be seen in all its grandeur as a part of the secondary but magnificent group of buildings which centers about the Wooded Island. This latter alone is a study in landscape gardening, worthy of a separate article, which is given to it in the current issue of "Scribner's Magazine." The way in which the formality of the buildings and parterres is shaded off into the lagoon by fringes of marshy plants which are repeated on the shores of the central island, and the contrast between this treatment and that of the Grand Basin (a contrast which is carried out in the arrangement of the buildings also) is one that if studied cannot but give pleasure.

Which of the buildings is the finer architecturally is a hard question, even for architectural experts. We do not assume to be such, and therefore will not attempt to answer that question. There are, however, at least eight buildings, the Administration, Agricultural, Machinery (well named the "Palace of Mechanic Arts"), Manufactures and Liberal Arts, Mining, Electricity, Art and Fisheries buildings which seem to the lay observer practically perfect. Whichever one he looks at for some time he finds the conviction growing on him that it is the gem of the Exposition; yet each of these is different, and some are markedly dissimilar. The same is as distinctly true of the Peristyle and its two connected buildings, utilized as a music hall and casino.

It is a great pleasure to look at each of these buildings in turn as a separate structure, and find one's admiration for it growing, and it gives even the most unthinking visitor a feeling of sadness which one hears incessantly expressed to think that all these architectural glories have come up as a dream and are to vanish as such. In fact, the very name "Dream City" has been given to the Exhibition, and is strikingly appropriate. Nowhere else but in some dream like Rider Haggard's of undiscovered African cities have such vast and splendid architectural effects existed. Could the structures as they now exist only be perpetuated in the marble which they simulate they would dwarf all other structures of both the new and old world, and of both ancient and modern times, in fame and beauty.

The Horticultural and Transportation buildings and the great railway station are also grand and effective structures, and the Woman's Building just misses being equally effective as a whole, and is so in many of its details. For the first serious effort of a young architect, whether man or woman, it is a most successful design. No one of these four structures can be considered unworthy of its company, though they hardly seem, to us at least, to attain the highest level of perfection, as the others do. The same is true of a dozen or so music halls and minor pavilions, which we will not enumerate in detail.

Of all the buildings so far referred to, the Transportation Building is the only one which is not white; and it relies largely on color for its architectural effect, though it has one very grand and effective architectural feature, the "golden door." The choice of color was doubtless made with the idea of introducing a pleasing variety among the buildings, and not wholly without success, for the effect of the building is really fine, but we fancy that the architects themselves, if they had the work to do over, would have preferred a less marked contrast and by slightly altering the style have adhered to the white of the other buildings.

The two comparative failures among the larger buildings, and the only two among any of the buildings, large or small, which are decided failures, are the Government and the Illinois buildings, both of which are chiefly offensive for their ugly domes. The Illinois Building is a pitiable failure, perhaps because it was copied too faithfully from the Illinois State House. It is, moreover, not only an ugly but an inconvenient building, owing to the absurd and thoughtless error of requiring the visitor to go up and down three flights of stairs in order to see all of the galleries, which yet are all but connected. There is a certain air of brazen and uncouth assertiveness about the lines of the building, and especially its dome, which makes it a specially unfit neighbor for the Art Building which it half obscures, and whose dome and whole design is as conspicuously beautiful as the other is ugly. The Government Building does not offend in quite the same way as the Illinois Building, nor quite so much, but the row of dumpy round windows which cut the dome in two, with various other like details, shows up the building for what it is, the hackwork of some facile wooden-headed draftsman, instead of the study of an artist.

From the point of view of the public interest, perhaps these two failures are not so much to be regretted. They have not only resulted in the adoption of a new and better system for our government buildings, but they bring out the difference between good and bad architecture in sharp relief, as it was never brought out before, at least in this country, and this cannot but leave its mark upon our public architecture for a century to come.

USE OF PLATE GIRDERS FOR ARCH CENTERS.

The use of iron plate girders in arch centers is illustrated in the "Centralblatt der Bauverwaltung," from which periodical we reproduce the accompanying engraving. The bridge in question is a three-arch masonry and concrete highway bridge across the River Spree, connecting a suburban district with the city of Berlin, Germany. The masonry arches of 53.5 ft. span and 8.7 ft. rise have concrete spandrel backing; the piers and abutments consist of masonry. For roadway Norway pine wood paving is employed, the interstices between the blocks being filled with cement mortar. The sidewalks are of granite flagging. The required width of passageway for river craft was 10 m. (32.8 ft.). This and the low arch construction necessitated the use of plate girders in the erection of the centers. The details of the latter are quite clearly shown in the accompanying illustration.

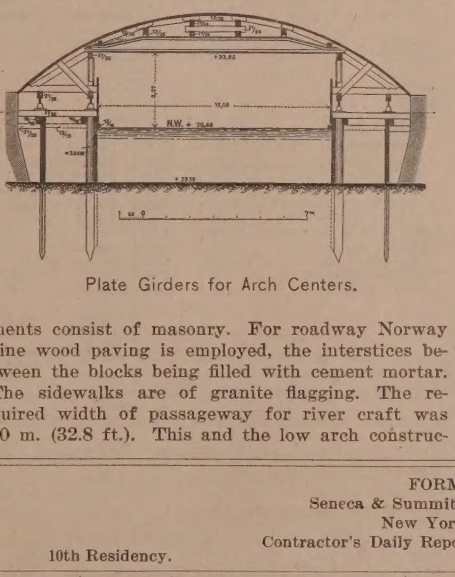

Plate Girders for Arch Centers.

FORTY YEARS OF THE SAULT STE. MARIE CANAL.

On June 4, 1853, ground was broken for the first lock and canal around the falls of the St. Mary River, and the "Leader," of Superior, Wis., thus epitomizes the history and progress of the canal to the present date:

In 1837 the governor of the newly admitted state of Michigan, in his first message, advised the Legislature to make a canal and locks at the rapids of Sault Ste. Marie. He continued agitation until the subject was brought up in the Senate of the United States, by which, in spite of the most violent opposition from the South, a survey was ordered by the engineers of the United States Army.

In 1852 a grant of 750,000 acres of public lands was made by Congress in trust to the state of Michigan, the proceeds to be used in making a canal at the Soo with locks not less than 250 ft. in length, 60 ft. in width, and 12 ft. in depth, work to be begun in three and finished in ten years; government boats to pass through free of toll, and other boats to be charged no greater tolls than might be required to keep the canal in repair after the expenses of construction had been paid.

Michigan accepted the grant under the conditions imposed, and immediately turned over the entire project to a private corporation. The first survey was made by Capt. Augustus Canfield. Ground was broken on June 4, 1853. On May 21, 1855, the government commissioners signed a certificate of completion, and, on June 18 following, the first boat, the careening and noisy steamer "Illinois." Capt. Jack Wilson, was locked through. These old locks and the canal which cost exactly $999,802.46, were considered the most marvelous marine works of the age.

On Oct. 20, 1870, commerce to Lake Superior having greatly increased, a contract for a new lock was let. The first stone was laid July 25, 1876, and the first steamer was locked through Sept. 1, 1881.

This was at that time the largest ship canal lock in the world. It was 515 ft. in length, 80 ft. in width, 39½ ft. in depth, with 17 ft. of water on the miter sill. Its cost was $2,150,000, and it was called the most perfect piece of marine engineering in existence. All of the machinery necessary to operate these locks is driven by two 30-in. turbine water-wheels. The lock fills in 11 and empties in 8 minutes.

Commerce having further increased and lake ships having become nearly as large as ocean vessels, a still larger lock was necessary. It is now in process of construction on the site of the old locks of 1885. It will be 800 ft. in length, 100 ft. in width, 43½ ft. in depth, with 21 ft. of water over the miter sill. Work was begun on it in the spring of 1887 under Gen. O. M. Poe, and it will cost a little more than $5,000,000. Its capacity will be the lifting of four vessels each 350 ft. in length and 46 ft. in width, at a single lockage either way.

Since June 6, 1891, no tolls have been collected for vessels passing through the Soo Canal, except for a few months during 1892, when Canadian vessels were charged a retaliatory toll to compensate for the discriminating tolls levied on American shipping passing through the Welland Canal.

KEEPING RECORDS OF CONTRACTORS' "EXTRA WORK."

Every engineer has had his own experience, more or less variegated, in keeping track of extra or force account work, performed by contractors. A number of methods exist for keeping an intelligent check upon the amount and character of this work, but one of the best we have yet seen is here given from a correspondent, in his own words, as follows:

FORM NO. 1.
Seneca & Summit Railroad Company.
New York Division.
Contractor's Daily Report of Extra Work Done.
10th Residency. Friday, May 5, 1893.

Section.	Station.	Character of work done.	Force employed.	Rate.	Separate amount.	Total amount.
43	101 + 30	Excavation foundation, east abutment Beaver River bridge.	1 foreman 5 masons 10 laborers 3 teams 1 blacksmith 1 carpenter 20 lbs. dynamite 600 ft. B. M. lumber 50 lbs. nails	$3.00 2.50 1.20 3.00 2.00 1.75 .20 12.00 .05	$3.00 12.50 12.00 9.00 2.00 1.75 4.00 7.20 2.50	$53.95

Certified by John Smith, Contractor.
Examined by Thomas Brown, Engineer.
Total, $53.95
Amount allowed, 53.95

Extra work or force account work, that is, work done by the contractor by day's labor, for which he receives, in addition to the actual cost, also a percentage to compensate him for use of tools, superintendence, profit, etc., is usually a source of contention between engineers and contractors. As usually done the contractor hands in at the end of the month a statement of work done, and, where there has been no check kept by the engineer, is sometimes disputed, especially if the amount of the bill seems large and greater than the engineer had reason to believe it would be.

FORM NO. 2.

Seneca & Summit R. R. Co New York Division.
Daily Statement of Force Employed by
John Smith, Contractors, on E. Abutment, Beaver R. Bridge, Station 101 + 30, Section No. 43.
William Gray, Foreman.

Designation of Labor and Material.

May, 1893.		Foremen.	Masons.	Laborers.	Teams.	Blacksmiths.	Carpenters.	Dynamite.	Lumber.	Nails.
S										
	Total,									
S										
M										
T										
W										
T										
F	5	1	5	10	3	1	1	20	600	50
S										
	Total,	1	5	10	3	1	1	20	600	50
S										
M										
T										
W	10	1	4	10	3	1	1	10	600	50
T	11	1	3	11	3	1	1		500	40
F	12	1	2	9	4	1	1	10	900	60
S										
	Total,	3	9	30	10	3	3	20	2,000	150
S										
M										
T										
W										
T	18	1	3	12	2	1				
F										
S										
	Total,	1	3	12	2	1				

Designation of Labor and Material.

May, 1893.		Foremen.	Masons.	Laborers.	Teams.	Cement.	Powder.	Fuse.		
S										
M										
T										
W										
T										
F		1	2	15	4	6	20	100		
S										
	To[illegible]	[illegible]	2	15	4	6	20	100		
S										
M										
T										
W										
T										
F										
S										
	Total,									

Summary.

Designation of labor and material.	Week ending May 6.	Week ending May 13.	Week ending May 20.	Week ending May 27.	Week ending —	Total.	Rate.	Amount.
Foremen..	1	3	1	1		6	$3.00	$18.00
Masons....	5	9	3	2		19	2.50	47.50
Laborers..	10	30	12	15		67	1.20	80.40
Teams.....	3	10	2	4		19	3.00	57.00
B'smiths ..	1	3	1			5	2.00	10.00
Carpenters	1	3				4	1.75	7.00
Dynamite.	20	20				40	.20	8.00
Lumber...	600	2,000				2,600	12.00	31.20
Nails..	50	150				200	.05	10.00
Cement..				6		6	1.50	9.00
Powder....				20		20	.10	2.00
Fuse.......				100		100	.01	1.00
Totals.								$281.1

Paul Jones,
Timekeeper.

Thomas Brown,
Res. Engr.

The writer having had some experience of this kind and in order to avoid trouble and annoyance, inaugurated a system, which, after a long trial, proved entirely satisfactory. The main feature of the plan was rendering daily accounts of extra work done. For this purpose the blank No. 1 was got up and a supply furnished the contractors. They are 7 × 8½ ins. in size and put up in blocks of 50. A certain class of extra work having been duly authorized by the engineer, say, for instance, the excavation of a wet foundation for a bridge, on the day following the first day's work the contractor sends to the engineer a concise statement of all labor employed and materials used for that day, the statement being duly certified.

In order that the company may have a check upon the contractor the company's timekeeper is provided with suitable pocketbook, arranged as per the reproduced copy, Fig. No. 2. This book is 4¼ × 7 ins. in size and contains 100 pages. The timekeeper on his daily rounds over the work notes in this book the number of men employed and the materials being used.

These statements are then compared and if found to tally are then entered into another book arranged for the purpose. This book, of which we show a reduced page, contains 100 pages. The various items are entered daily, and the total amounts placed in the right-hand column. At the end of the month the vertical columns are added up and placed in the summary column at the bottom of the page, the amount carried out when it is in shape for making up a proper bill, the agreed percentage being added

FORM No. 3.

9J

Seneca & Summit Railroad Co., New York Division.
Monthly Report of Extra Work.
Residency No. 1', Section No. 43, John Smith, Contractor.
Kind of Work, Excavation Foundation, E. Abutment, Beaver River Bridge.

Labor and Materials.

Rate.													Amo'nts.	
Date. May, 1893.	Foremen.	Masons.	Laborers.	Teams.	Blacksmiths.	Carpenters.	Dynamite.	Lumber.	Nails.	Cement.	Powder.	Fuse.	Dols.	Cts.
5	1	5	10	3	1	1	20	600	50	..	.	...	53	95
10	1	4	10	3	1	1	10	600	50		..	..	49	45
11	1	3	11	3	1	1	..	500	40	..	.	..	44	45
12	1	2	9	4	1	1	10	900	60	.	..	....	50	35
18	1	3	12	2	1	.	.	....	...	..	..	....	32	90
26	1	2	15	4	..	..		......	.	6	20	100	50	00
Totals...	6	19	67	19	5	4	40	2,600	200	6	20	100	281	10

Summary.				Remarks.
No.	Items.	Rate.	Am'ts.	
6	Foremen.........	$3.00	$18.00	Work done in accordance with instructions received from Chief Engineer, under date of April 9, 1893. Work now complete. Amount of bill, $281.10 Add 15%..... 42.17 Total ..... $323.27 Thomas Brown, Engineer.
19	Masons.......	2.50	47.50	
67	Laborers.........	1.20	80.40	
19	Teams...........	3.00	57.00	
5	Blacksmiths.....	2.00	10.00	
4	Carpenters.......	1.75	7.00	
40	lbs. Dynamite..	.20	8.00	
2,600	ft. B. M. Lumber.	12.00	31.20	
200	lbs. Nails........	.05	10.00	
6	bbls. Cement....	1.50	9.00	
20	lbs. Powder......	.10	2.00	
100	ft. Fuse..........	.01	1.00	
Total amount for May, 1893.			$281.10	Continued on page........

In the forms here given it should be remembered that the originals are blanks, in which the name of the railway, date and residency, in Form No. 1, are left to be filled up in ink. In Form No. 2 the heading is filled up in a similar manner, apparent to any engineer. The heads under "designation of labor and material" are also to be filled as occasion demands, both Forms 2 and 3, and the details of the "Summaries" are treated in a like manner.

PERSONALS.

Mr. C. W. Gibbs, formerly of the engineering department of the Rio Grande Southern R. R., has opened an office at Durango, Colo. for general engineering and mining work.

Mr. B. F. Bond has been appointed Superintendent of Bridges and Buildings of the Jacksonville Southeastern R. R., with headquarters at Jacksonville, Ill., vice Mr. A. J. Kelley, resigned.

Mr. Marcellus Hopkins, formerly Division Superintendent of the Iowa lines of the Chicago & Northwestern R. R., has been appointed General Manager of the Chicago & South Side Elevated Ry.

Mr. G. Erickson has been appointed Engineer of Maintenance of Way of the Pittsburg, Fort Wayne & Chicago R. R., with offices at Fort Wayne, Ind., vice Mr. Thomas Jackson. Mr. Erickson was formerly with the Columbus & Hocking Valley R. R.

Mr. M. J. Byers has been appointed Engineer of Maintenance of Way of the Columbus & Hocking Valley R. R., vice Mr. G. Erickson, resigned to accept a similar position on the Pittsburg, Fort Wayne & Chicago R. R.

Mr. H. H. Vreeland, formerly General Manager of the New York & Northern R. R., has been elected President and General Manager of the Houston, West Street & Pavonia Ferry Railroad Co., which operates the Broadway cable road and other street railways in New York city owned by the Metropolitan Traction Co.

Mr. Lewis K. Davis, M. Am. Soc. M. E. and M, Am. Inst. M. E., 1 Broadway, New York, N. Y., is prepared to make reports on the remodeling of manufacturing plants, the designing of power stations, and to do any other work in the line of consulting mechanical engineering. He has for the past two years been mechanical engineer for the National Lead Co.

Mr. W. M. Hughes, M. Am. Soc. C. E., has resigned his position as City Bridge Engineer of Chicago, to accept a position as Principal Assistant Engineer of the Metropolitan Elevated Ry. with office in the Monadnock Block, Chicago. He was formerly Assistant General Manager of the Keystone Bridge Co., and has held the position he now leaves for the past two years.

Mr. Charles Atwood has resigned his position as Designer-in-Chief of the World's Columbian Exposition and formed a partnership with Mr. D. H. Burnham, Director of Works of the Exposition, to carry on a general practice as architects. Their offices will be the Rookery Building, Chicago. Among the Exposition buildings designed by Mr. Atwood are the Art Building, Music Hall, Casino, Peristyle, Forestry Building and the Terminal Station.

NEW PUBLICATIONS.

THE DRAKE TECHNIC. Vol. I., No. 1. Published by the Engineering and Scientific Society of Drake University, Des Moines, Ia. 8vo; pp. 98. 50 cts.

The engineering department of Drake University, which is most creditably represented by this publication, is another illustration of the amazingly rapid multiplication of engineering schools. Drake University itself is a very modern institution, and its engineering department was not organized until 1888. It now has ten departments besides engineering, and the freshman class in engineering numbers seven students, which is more than many much older schools have. The Technic contains several very creditable papers, and makes somewhat of an innovation by publishing in connection with its papers portraits of the authors, and also by publishing perspetive views of its buildings drawn by some of its undergraduates, which certainly are very creditable work of its kind. Altogether, Drake University seems to be a promising and live institution.

TRADE PUBLICATIONS.

BRAKE SLACK ADJUSTERS.—Hinckley Brake Co., Trenton, N. J. 8vo; pp. 26; illustrated.

This is a description of the Hinckley automatic brake slack adjuster for different arrangements of brake rigging, as described in another column.

INDUSTRIAL RAILWAYS. C. W. Hunt Co., New York. Abstract No. 193. 8vo; pp. 20.

The great variety of plant manufactured by this company is well illustrated by this supplementary pamphlet, which shows some new forms not given in its regular catalogues.

SOCIETY PROCEEDINGS.

ENGINEERING CONGRESS—MECHANICAL ENGINEERING SECTION.—The following provisional program is announced for this section of the congress at Chicago, which section is under the management of the American Society of Mechanical Engineers:

Monday, July 31—General session of all sections; addresses from officials of the Congress and replies. Section B (Mechanical Engineering) adjourns to its allotted hall, and transacts any general business, reports of election, appointment of nominating committee or special committees, etc. It is not expected that any papers can be presented at this session.

Tuesday, Aug. 1 to Friday, Aug. 4.—Report of stand-

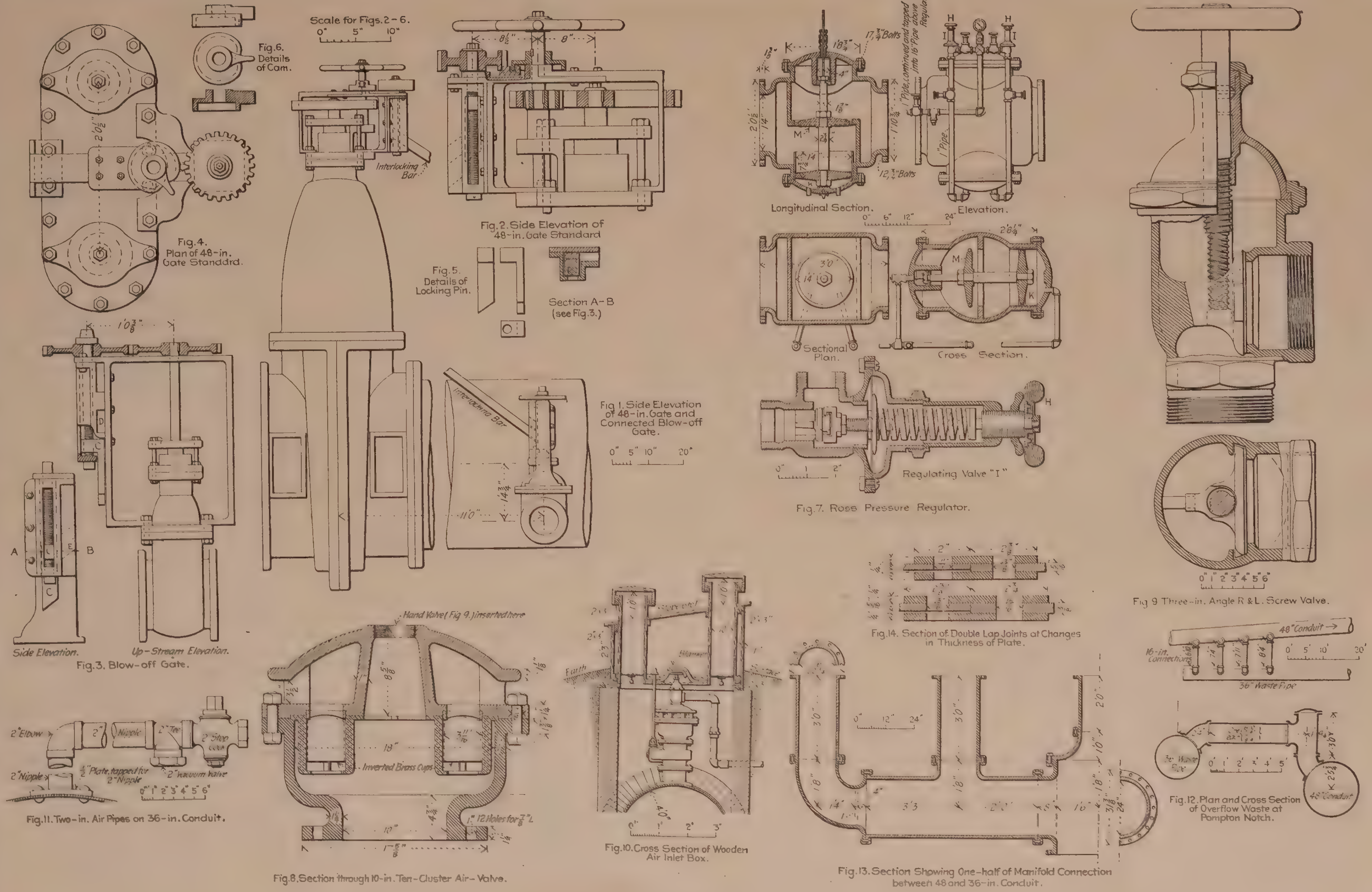

Fig.6. Details of Cam.

Fig.4. Plan of 48-in. Gate Standard.

Scale for Figs. 2-6. 0" 5" 10"

Fig.2. Side Elevation of 48-in. Gate Standard

Fig.5. Details of Locking Pin.

Section A-B (see Fig.3.)

Side Elevation. Up-Stream Elevation.

Fig.3. Blow-off Gate.

Fig 1. Side Elevation of 48-in. Gate and Connected Blow-off Gate.

Longitudinal Section. Elevation.

Sectional Plan. Cross Section.

Regulating Valve "I"

Fig.7. Rose Pressure Regulator.

Fig 9 Three-in. Angle R & L. Screw Valve.

Fig.14. Section of Double Lap Joints at Changes in Thickness of Plate.

Fig.12. Plan and Cross Section of Overflow Waste at Pompton Notch.

Fig.11. Two-in. Air Pipes on 36-in. Conduit.

Fig.8. Section through 10-in. Ten-Cluster Air-Valve.

Fig.10. Cross Section of Wooden Air Inlet Box.

Fig.13. Section Showing One-half of Manifold Connection between 48 and 36-in. Conduit.

Details of 48-in. Steel Pipe Line for the New Water Supply of Newark, N. J.

CLEMENS HERSCHEL, M. AM. SOC. C. E., ENGINEER AND SUPERINTENDENT, EAST JERSEY WATER COMPANY.

A. F. ROBINSON - Personal

ing committee on Uniform Methods of Testing Materials, and to Recommend a Standard Method for Testing Efficiency of Locomotives.

"Tests of Purdue University Locomotive," W. F. M. Goss; "Locomotives Operated by Total Adhesion," A. Mallet; "Compound Locomotives," A. von Borries; "Experience in Working of Rack Railways," A. Schneider; "The Working of Centrifugal Machinery," Gust. Herrmann; "The Removal of Dust in Workshops," R. Kohfal; "The Taxameter or Fare Indicator," C. Pieper; "Apparatus for Metering Steam," Franz Seiler; "Improvements in the Art of Cable-making," Emil Guilleaume; "Measuring of Water and the Schinzel Water Meter," F. Lux; "Contribution to the Theory of the Steam Engine," V. Dwelshauvers Dery; "Limitation of Engine Speed," C. T. Porter; "Compression as a Factor in Steam Engine Governing," F. H. Ball and D. S. Jacobus; "Performance of a Triple Expansion Pumping Engine, With and Without Jackets," J. E. Denton; "Performance of Street Railway Power Plants," William A. Pike and T. W. Hugo; "An Evaporative Surface Condenser," James H. Fitts; "A Coal Calorimeter," George H. Barrus; "Anhydrous Ammonia Gas as a Motive Power," T. W. M. Draper; "A General Engineering Classification and Index," William L. Chase; "Notes on the Drainage Machinery of the Netherlands," A. Huet; "The Refrigerating Machine of To-day," C. Linde; "The Interchangeable System of Manufacture," W. F. Durfee; "Rod-Rolling Mills and Their Development in America," F. H. Daniels; "Technical Education in the United States," R. H. Thurston; "Haulage by Horses," Thomas H. Brigg.

Saturday, Aug. 5—General session of all sections, concluding addresses, and general business. It is not expected that there will be any papers presented at this closing session, which will terminate by adjournment.

F. R. Hutton, Secretary.

ENGINEERS' CLUB OF PHILADELPHIA.—The regular business meeting was held June 17, President John Birkinbine in the chair. Fifty-three members and visitors present. Mr. C. H. Roney opened a verbal discussion on "Some Data in Reference to Modern Office Buildings" by calling attention to the rapid changes which had taken place in the construction of buildings of this class within comparatively a few years. Formerly they were built like dwellings, and of not more than five or six stories, but now the introduction of elevators has been followed by an increase in height to an average of twice the above number of stories. All parts of the construction are made as fireproof as possible, wood being used only where nothing else can be substituted for it. Methods of supporting the floors, and bracing to withstand wind pressure, were described and illustrated by blueprints of typical buildings in Chicago and Philadelphia. In some cases the columns of successive stories support one another, and in others are made practically continuous. A model of the Phoenix column, showing the latter method, was presented as an illustration. Other details of construction were described by Mr. Roney, and in conclusion a series of photographs were projected by the lantern, giving typical examples of modern office buildings in various stages of completion.

Mr. Howard Constable inquired of Mr. Roney whether he had formed any opinion as to what was the practical deviation from the vertical allowable in the erection of the main columns of high buildings and framework of elevator shaft. Mr. Constable's opinion, in a special case, was that 1½ ins. in 200 ft. was too much in an elevator shaft to be passed as first-class work, and not within the limit of what should be allowed for general practice. He called attention to the fact that this was a point upon which engineers would have to post themselves, as it bears an important relation to disputes between the structural contractors, the stair-builders and the elevator people. These disputes arise from the pressure that is brought to bear to complete these buildings in a very short period; therefore, the rapid getting in of stairs and elevators becomes very important, although very little of the work is got out until measurements from the building can be taken—the manufacturers of these parts generally finding it very unsafe to work from drawings, and feeling no certainty as to what the deviation on the part of the other mechanics will be. He also called attention to the fact that as yet very little attention is given by the architect and structural engineer to providing for the various pipe systems necessary in all high buildings. He thought they ought to be planned for as carefully as many other parts, and showed how the putting in of gas, steam and electric piping, etc., very seriously weakens some beams in the floor arching or the wall, also that the ordinary hollow tile for floor arches is peculiarly ill adapted for being cut through for piping. In answer to a question from Mr. James Christie regarding the corrosion of iron buildings from the effect of the dampness in the brick and mortar, he said he had found no case where any iron section resisting a strain was injured over ½% of its effective section; but that where columns are used for leaders, or where there are pockets where the water can collect and remain, the corrosion might be very serious.

Mr. Christie called attention to the probable inadequacy of the transverse bracing on many high metallic buildings. For thin floors, substantial metallic plates of corrugated section are now used, having ample stiffness, with total vertical depth not exceeding 1-30 of the span, and the weight of metal in the floor can be safely reduced to 15 lbs. per sq. ft.

Mr. Constable took exception to the circle formed by the radius of arch-blocks being considered as representing the line of force in the arch: 1st, because a circular arc does not represent the line of pressure in the arch, and 2d, because the radius and bevel of these blocks is an assumption by the manufacturers for some special span, and is not varied to suit every span, additional blocks simply being added for increase of span. A simple rule for approximating the strength of these arches is to consider the load as concentrated in the middle, and to represent it graphically by the efficient depth of the block, and then to find what would be the resultant from the top of the arch down to the springing line where the arch block bears against the iron beam. Then, if there is enough cross-section of material to resist this resultant, the arch will stand. Mr. Henrik V. Loss stated that the existing friction between the surfaces in action undoubtedly made the arch act partly as a bearer by preventing or offering resistance to any sliding action that otherwise would occur with joint lines not theoretically correct. Mr. John C. Trautwine, Jr., described a fireproof floor designed by E. D. Lindsey, of New York, consisting of a wire netting suspended over two adjoining floor beams and encased in a mass of light concrete containing plaster of Paris and sawdust. Mr. Constable called attention to the very important consideration in all of the tile and concrete floors of the effect of concentrated weight, such as is caused by a heavy safe resting on four wheels. (Mr. Trautwine suggests by letter that this difficulty might be obviated by placing under the safe an iron plate sufficiently large to receive all four feet and thus distribute the weight.) Mr. Constable illustrated a floor that he had recently used consisting of a series of arch bars interlaced together and butting against a frame extension around the room. The triangular space between these bars was filled in by pressing an air bag up from the other side, and casting a plaster of Paris arch over the bag, and when the plaster was set, removing the bag; then on top of these bars and plastered arches filling in with ribs of fine concrete and then putting on the wooden or mosaic floor. He stated that he had got better results in ordinary brick arches, between beams, by placing the tierods close at the bottom flange of the beam instead of halfway up, as is usual.

L. F. Rondinella, Secy.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The summer meeting was held on the afternoon and evening of June 30, at the Hotel Rockledge, on the top of Mill Mountain, 850 ft. above Roanoke; Charles C. Churchill, President, in the chair, and 20 members and 3 visitors present. In his annual address the President took up the subject of the development of southwest Virginia, dealing first with the historical facts connected with it in the last twelve years, beginning with the acquisition of the present Norfolk & Western R. R., by its present owners and tracing the growth of the road on the lines of a purely mineral development and consequently general growth of prosperity of the region traversed. Then, taking up the engineering features of this development, he noted the principal works necessary to undertake in the penetration of the Alleghany Range into and through West Virginia to beyond the Ohio River, and made especial note of the Ohio River bridge at Kenova, which, on account of the thoroughness and accuracy of the preliminary surveys, is one of the few on record where no change of any kind was made in the original location. After his address Mr. Churchill referred to his paper, read last year before the Association, on the establishment of a United States weather signal station, at Roanoke, and gave some additional information and correspondence on the subject. A resolution was offered and passed urging upon the proper authorities the establishing of a signal station in the vicinity of Roanoke.

Mr. R. P. C. Sanderson presented a paper on the "Proper Method of the Disposal of Sewage and Household Waste in Isolated Buildings Where No Drainage System can be made Available." His main effort was directed against the present foul and unhealthy cesspools so common in small towns, when the whole ground is gradually getting polluted and offering a most inviting ground for fever and cholera germs. Against this method, he showed how, by a proper separation and disposal of solid and liquid wastes and the use of water-tight cesspools, perfectly healthy arrangements can be made at small expense. In connection with the filling up of old cesspools, after the establishment of a drainage system, and in view of the fact that the city of Roanoke is now in that stage, strong resolutions were adopted by the Association, for presentation before the city council, urging the proper methods for doing this work. Mr. James H. Fitts, in a paper on an "Evaporative Surface Condenser," described a new form of condenser built by himself at the Virginia Agricultural and Mechanical College, at Blacksburg. Increased rapidity of evaporation is secured by the passage of fresh air over the water surfaces in which the steam tubes lie in horizontal rows, thus removing the vapor as it rises and hastening evaporation. The heat necessary to produce evaporation is obtained from the steam in the tubes, causing the steam to condense. The machine is still in a crude form, but enough has been done by it to show that it offers a practical solution of the question of condensation of vapor with a small water supply.

At the evening session Mr. William M. Dunlap read a paper on "Brick Pavements," giving a detailed description of the methods used in paving the streets of Roanoke with vitrified brick. Considerable discussion followed this paper, and was followed by a still more animated discussion on "Municipal Building Laws," the lack of power ordinarily given to the building inspector to condemn and adequately punish violations of the law being clearly brought out by Mr. Clarence Coleman, in a short paper opening the discussion. As a result a committee was appointed to draft a set of rules which after discussion and approval by the Association, is to be offered to the city council as what constitutes a complete set of building laws for the city of Roanoke. In the absence of Mr. H. W. Newby, his paper on the "Improvement of Virginia Highways," was read by the Secretary. The writer's main aim was to advocate the use of convict labor, under the direction of competent road engineers, as the solution of the problem for the sparsely settled districts of this state, where the present road laws are an absolute failure, and where the only other solution offered, i. e., the issuing of bonds, would be too heavy a load for the county to bear. A committee was appointed to take up this question in detail and to frame, for presentation before the State Legislature, a suitable bill embodying the Association's views on the question.

L. J. Carmalt, Sec'y.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
July 15. 1122 Girard St. Secy., L. F. Rondinella.
SWEDISH ENGINEERS' CLUB.
July 15. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
COLUMBIAN ENGINEERING SOCIETY.
July 18. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
July 18. Secy., R. H. Clark, Pittsburg.
ENGINEERS' CLUB OF ST. LOUIS.
July 19. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF CINCINNATI.
July 20. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
July 20. Secy., C. F. Franson, Portland Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
July 28. Secy., C. H. McLeod, Montreal, P. Q.
AMERICAN INSTITUTE OF MINING ENGINEERS.
July 31 to Aug. 5. Chicago, Ill. Secy., R. W. Raymond, 13 Burling Slip, New York.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. Collingwood, 127 East 23d St., New York.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. R. Hutton, 12 W. 31st St., New York.
WESTERN SOCIETY OF ENGINEERS.
Aug. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Aug. 3. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Aug. 4. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 4. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Aug. 8. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Aug. 8. Ryan Hotel, St. Paul. Secy., W. D. Crosman.
NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 8. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
Aug. 8. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Aug. 9. Wichita, Kan.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE
Aug. 10. Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Aug. 10. Secy., W. G. Kirkpatrick, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Aug. 11. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Aug. 12. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Aug. 14. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Aug. 14. Secy., M. F. Schinke, City Hall.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Aug. 18. 201 Washington Building.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.
NEW ENGLAND RAILROAD CLUB.
Sept 13. Secy, F. M Curtis, O. C. R. R., Boston.
WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept. 21. Secy., S. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon: new advertisements, Tuesday afternoon: transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering Headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there.

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In another column are briefly outlined the efforts of the Krupps, father and son, to better the condition of the army of workmen employed at Essen. Their plan of operations and the evident strong personal interest taken in the condition of their employees are in striking contrast with the spasmodic philanthropy of the average master of great industrial establishments. Instead of now and then donating a school, a church, or a reading-room, or even building a workingman's town, and operating it so as to profit directly by the scheme, the Krupps have from the first taught their men to help themselves, to improve their whole system of living and to understand that their employer ever had their welfare keenly at heart and was ready to divide with those who deserved it a considerable amount of the profits of this great establishment. It is by this constant watchfulness over their men, in the better sense of the word, and by this constant personal contact with all employed by them, that the Krupps have accomplished great and substantial good. The tendency of their system has been to make the men respect themselves and their work and so love their master to a much greater degree than is usually the case among men of this class, and while they are assisted in building houses for themselves, and in supporting sick-funds, pension funds and life insurance schemes, they are made to feel that there is no degrading charity connected with the benefits obtained. In a word, the master and the founder of this system was once a workman himself; and while enterprise and intelligent effort placed him and later his son at the head of the greatest and most famous industrial establishments, he showed by his work for them that he was still one of them as far as their comfort and prosperity were concerned. The cordial relations evidently existing between the master and the men of Essen teach us that the employer must keep in very close touch with his employees if he wishes to retain their good-will and to obtain from them their best service. The tendency of the times is toward a concentration of interests and a massing of labor, and it will be well for our immediate political future if the masters generally study with more care the example set by the Krupps, of Essen, in the management of workingmen.

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England, with her awkward system of currency and traditional firmness in adhering to English customs, would be the last place in which we would look for the adoption of the metrical system in the manufacture of machinery. Yet such is said to be the case, and Messrs. Willans & Robinson, of Thames Ditton, Surrey, the most prominent builders of high-speed engines in England, are credited with the determination to hereafter construct all new engines upon even measurements on the metrical system, and Mr. Charles L. Hett, of the Turbine Works, at Brigg, is also said to be contemplating a similar change of standards. While it is not so stated, it is to be supposed that both manufacturers are influenced by the demands of foreign buyers already familiar with the newer standard, and that a wish to better meet this demand has brought about this radical change of methods. To meet the often expressed difficulty of changing existing gages, templates, etc., the firms mentioned propose to leave these unaltered, but for the sake of uniformity in the works they will restamp all of them to the nearest hundredth of a millimeter. It is a little curious that England, which now depends so largely upon her trade with countries which have adopted the metric system, and the United States, which should be an active competitor for this trade, should be the chief and only prominent adherents of the old standards of weights and measures. These are bad enough when used at home, and their deficiencies are constantly apparent; but that we should attempt to force them upon nations preferring a simple and more perfect system is not business, to say the least. The metric system is now so firmly established in so many countries that English standards are practically unknown, or at least little understood outside of England and the United States; and it is altogether natural that these other countries should prefer to buy in French and German markets where machinery and almost everything else are dimensioned and measured by a familiar standard. The world is narrowing down rapidly, and it is only policy for trading nations to meet this tendency as soon as possible by adopting certain universal standards. It must come sometime, and the action of a few more prominent English firms will do much to hasten the adoption of the metric system in American workshops.

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Of the many special and novel features suggested for the World's Columbian Exposition and intended to take the place of the Eiffel tower of the Paris Exposition of 1889, the only one actually completed is the Ferris wheel, lately opened to the public in the Midway Plaisance. A revolving wheel carrying passengers is not itself a novelty, and is common enough at many summer resorts; but this steel wheel, 250 ft. in diameter, beautifully balanced and superbly braced, is a masterpiece of constructive engineering and a credit to its skilled and daring designer. It towers above all else in its immediate vicinity and is in itself one of the most interesting engineering exhibits at the World's Fair. We expect to give the structural details of this wheel in a later issue.

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In an article on automatic brake-slack adjusters in our issue of June 8 we unfortunately, through a misunderstanding for which this office was responsible, did an injustice to the Hinckley Brake Co, by illustrating an early form of the Hinckley automatic adjuster instead of the improved form now manufactured by this company. In another column of this issue we illustrate and describe this improved form, thus correcting this injustice and at the same time showing one of the most promising of the devices which have been contrived for this important end, and some form of which seems likely before long to be very generally adopted. The great usefulness of such a device for insuring the best action of brakes is evident.

HOW BEST TO SEE THE WORLD'S COLUMBIAN EXPOSITION.

Up to the present time probably a small minority only of our readers have seen the great Columbian Exposition. An immense majority of them probably will see it, including many who at this moment rather think they will not go; for the cost of transportation is certain to be much reduced before the Exposition closes, and as the time for hesitation decreases the increasing chorus of praise from those who have seen it cannot but lead every one who can possibly spare the time and money to spend a few days at it at least. To these future visitors, perhaps, a few notes gathered on the ground as to what to do and to avoid, and as to the good and bad points of the exhibition will be useful, and even to those who have already visited it they may not be without interest. We need not say that if, in the judgment of any of these latter, we err in any way, we shall be pleased to have the error pointed out.

In general it may be said that while there are some annoying and needlessly defective features about the exhibition, chiefly in the restaurant service, which have been much harped upon, and not wholly without reason, yet these are relatively but trifling matters, and that the Exposition as a whole is far in advance of any previous one in almost every important detail, and by far the grandest which this generation is ever likely to have opportunity to see. As we have said before, our urgent advice to everyone who is $100 ahead of the world is to invest it in a visit to the Fair. He will not look upon its like again, while his chance is good to look on many another $100, some of which he may perchance be able to trace more or less directly to what he saw and learned at the exhibition. Not for profit, however, but for pleasure should one visit the Fair. The profit many may not get, by learning nothing directly useful to them which they did not know before. The pleasure no rational being can fail to get.

Most of our readers can, if they choose, reduce the expense of a visit considerably below the hundred dollars stated. An immense variety of rooms can be had all over Chicago, at extremely reasonable rates, the proverbial enterprise of the city having led its citizens to provide much more accommodation for visitors than there is as yet demand for, or than seems likely to be demanded. Many of these new buildings also have been put up by outside investors all over the West. In the immediate vicinity of the Fair, between Fiftieth and Sixty-fifth Sts., many thousands of rooms are available at prices varying from 50 cts. to $2 per day, the ruling rate in very comfortable buildings being $1 per day. For this sum at the present time the cautious visitor will have no difficulty in securing a room to himself. As the crowd of visitors increases this may be more difficult. By going further out along the line of the Illinois Central suburban service, to Seventy-fourth St., and elsewhere, still cheaper and entirely respectable accommodation can be secured within easy reach of the Fair by 5-ct. tickets. We have heard of rooms being let to parties of high-school students and the like as low as $6 per month by prior engagement, but the individual visitor will hardly expect to do as well as that. It is enough that he can house himself without difficulty, if he will, at $1 per day, while at the Auditorium and other down-town hotels, he can secure quarters at little, if any, advance on ordinary hotel rates. To show that it is not necessary to pay any excessive prices even in the business district, we may note that a building in the same block as the Auditorium, fronting on Michigan Ave., and just around the corner from the Engineering Headquarters, publicly advertises rooms at "75 cts., $1 and $1.50 per day." We have not seen these rooms, but they should have at least the supreme merit of cleanliness, as they were specially fitted up for the exhibition season new throughout.

Other rooms of like and better character may be had as yet in great abundance in the same vicinity; and there are certain great advantages in taking rooms here rather than nearer to the exhibition, the chief being that it is in the immediate vicinity of the station for express trains to the grounds (fare 10 cts., making no stops) and of the steamboat pier (25 cts. per round trip), so that it is nearer in time to the Fair grounds than any other point not in its immediate vicinity. To be lodged in the vicinity of the Engineering Headquarters will also be an advantage to all visitors who are engineers of any class, civil, mechanical, mining or electrical, since they have there practically a free clubhouse for their use in all but restaurant facilities, which has been especially provided by the subscription of engineers.

The visitor who does not take his family with him should by all means engage rooms only, taking his meals wherever he happens to be. Some he must perforce take within the grounds; he should make these as few as possible, as he will pay very high for very inferior meals, as a rule. In the immediate vicinity of the Fair, however, there are a great number of restaurants, all of which are reasonable and some of which are good. In the business district there are, of course, multitudes of restaurants to suit all tastes and purses. The prices of these restaurants are about the same as in New York and other large cities, and do not appear to have been raised on account of the exhibition.

The average visitor will find his day's work within the grounds so fatiguing that he will find even short walks outside of the Fair, which would ordinarily count for nothing, somewhat fatiguing. This restricts judicious choice of rooms, first, to the immediate vicinity of the grounds; secondly, to the down-town business district, especially near the lake front; thirdly, to the immediate vicinity of the Illinois Central suburban service, and fourthly, to the line of the new elevated railway and the Cottage Grove Ave. cable-cars. This gives him range of choice enough, and if he goes outside of it he is likely to regret it.

There are within the grounds two or three fairly good restaurants. That in the Woman's Building is on the whole the best, but small and overcrowded. The Marine Restaurant, near the Fisheries Building, and serving no meats, is sometimes good, sometimes bad and always dear. The so-called Banquet Hall, to the east of the Fisheries Building, gives fairly good service and fairly reasonable prices. Its easterly and much larger neighbor in the same building, an alleged clambake establishment, will be avoided by the judicious. A very fair table d'hote at $1 is served in the roof restaurant of the Transportation Building. Two or three of the restaurants in the Midway Plaisance, notably that in Old Vienna, are tolerably satisfactory. The less said about all the rest of the restaurants the better, since little good can be said of any of them. The so-called Vienna Bakery will seem but a hollow mockery to those who remember its Philadelphia prototype; and the restaurant service as a whole, including good and bad together, is almost infinitely inferior to that at Philadelphia or Paris or Vienna, and is the only approach to a serious blot upon the Exposition management. The philosopher will not regard it as a serious blot, but from a business point of view it was and is a most serious one, since it is likely to diminish by some millions the attendance at the Fair, especially among Chicago residents, begetting a feeling of irritation and resentment out of all proportion to its real importance.

It is easy enough to see how the error arose, and it is silly for any one to allow it to influence him enough to keep him away from the Fair, or even to cut short his stay. Every one has in his power the remedy which increasing thousands are adopting and which we advise every one to adopt, to carry a light lunch with him for consumption at any convenient time and place, instead of walking all over the grounds every day in search of the few and far-between places where he can be served with a reasonably good lunch at moderate price. The managers of the Fair have concentrated their energies on the herculean task which they have so successfully achieved, of finishing the building and grounds and installing the exhibits. This being done they have in intent (as we cannot doubt) trusted to the competition of the concessionaires to provide proper facilities for the comfort and material needs of visitors, avoiding any sensible expenditures of Exposition funds to this end, but taking care instead that every concessionaire should contribute liberally out of his profits to the general fund.

To this end every concessionaire on the ground (and there are some hundreds of them) contributes 25% of his gross receipts to the Exposition coffers, and out of the remaining 75% only must recoup himself not only for his current expenses and profit, but for the heavy installment expenses, and in some cases cash payments for the concessions, which he has incurred. These facts are to be remembered in considering the restaurant and other prices within the grounds, and as a rule the nominal restaurant prices will not seem high; but what makes them so in fact is that the prices are the same as are usual for portions sufficient for two or three persons, while the size of the portions has been cut down so as to be only sufficient for one person, and the waiters are instructed to refuse to serve them to more than one person.

But the practical effect of leaving all matters like this to the unchecked discretion of the concessionaires is that the management seem to stand toward the public in the odious attitude of having struggled hard and successfully to provide an unparalleled attraction for visitors, but after having done this at a cost all told of nearly $26,000,000 for buildings and grounds, to have expended neither money nor pains in providing for the small matters which, as we say, ought not to influence a philosopher when treated to so glorious a spectacle for so small a price, but which really do influence the average man out of all proportion to their real importance. To this, and to this only, is to be ascribed such grumbling as there has been amid the general chorus of praise, and the intending visitor should estimate it at its true worth, and not allow himself to be dissuaded from an intended visit in consequence. The grounds and buildings alone, as we have endeavored to show in part on another page, are worth a journey to Chicago to see, and will alone profitably occupy three to six days of time if not an exhibit be looked at. That this fact is generally appreciated will be evident at once to any one who remembers former exhibitions, and who notes with some care the proportion of visitors inside and outside the buildings. The latter class are a vastly larger porportion than at any other exposition. It is impossible to be accurate about such an estimate, but it is a fair guess that on pleasant and cool days pretty nearly half of all the visitors in the grounds will be found outside the buildings or in the state buildings. Wandering about the grounds to look at the buildings and the general effects seems to have an irresistable fascination for multitudes of the visitors, and very properly, for it is the grandest feature of the exhibition. As for the state buildings, they merit more detailed description, which we shall shortly give them. Some of them contain large exhibits of state products, and many of them interesting historical exhibits and relics; but they are in the main mere public clubhouses, elegantly appointed and furnished, and freely open to the use of all, whether residents of the state or not, for rest, for meeting friends, for writing letters, or any other like use. One or two of them contain also small restaurants, and most of them have upper rooms and balconies where lunches may be eaten. As such, they are one of the most novel, interesting and notable features of the Fair, the most surprising thing about them being that these privileges do not seem to be abused. How it may be at the end of the Fair one can only guess, but so far none of these buildings are sensibly the worse for wear, and those of costliest finish and provided with the most costly rugs and furniture seem to suffer least of all. The visitor makes a great mistake who does not go through all these buildings, and he can hardly fail to feel proud of his countrymen that such buildings can be safely thrown open to miscellaneous millions of them without abuse of the privileges.

What to see in the several main buildings is too much a matter of individual taste for us to attempt to give any advice. The intelligent technical visitor will find an immense amount to interest him in all the buildings, the only drawback being the constant inward pressure to "move on" which results from his inward consciousness that there is vastly more to be seen than he can possibly see in any reasonable number of weeks, work as hard as he will. The Transportation Building contains, perhaps, the most complete and satisfactory exhibit of any of the buildings, as may be judged from the fact that there are no less than 112 locomotives, or (in some cases) full-size reproductions of them on exhibition, if we counted them correctly, 53 of which are in the wonderful Baltimore & Ohio historical exhibit, which is one of quite unexampled merit and completeness, and for which that company and its efficient agent for this work, Major Pangborn, deserve immense credit. There was a peculiar appropriateness in this company undertaking such a work, however, for it is, perhaps, the only existing great company which can say of this whole era of development with truth, "All of this I saw, and a great part of it I was." The German track exhibit and the several rolling stock exhibits are also wonderfully complete, and there is hardly a detail of railway and wagon practice which is not well illustrated.

The machinery exhibit is on the whole rather disappointing, especially as a spectacle. The collection is of vast extent, but still there are very considerable gaps in it. The display of pumping engines, for example, it not to be compared with that at Philadelphia in magnitude and completeness, though in solid merit doubtless the contrary is the case. Similarly, though there are several engines on exhibition more powerful than the famous Corliss engine at Philadelphia, there is not one which approaches it in spectacular effect. The moral of this result is that commercial enterprise only should not be relied on for insuring proper exhibits in certain important and representative lines. For example, the Cramps or some other like concern might have been invited and paid something to set up a vast marine engine as a central feature. For lack of some such inducement not even a glimpse is to be had of modern practice in this vast department of steam engineering, excepting the great crankshaft in the Krupp exhibit and a few other like features.

Our space is exhausted before our subject is. Our columns will for some time to come give more details of all parts of the exhibition. In the meantime we will merely close as we began by advising all our readers who can possibly arrange to do so to visit the Fair, and by assuring them that they can do so if they will at very moderate cost. Whoever has any idea of studying any class of exhibits in detail should arrange to spend at least three weeks at the Fair, unless he is capable of Spartan self-denial in confining himself strictly to "business," as otherwise the first week will be fully exhausted in merely taking in the Fair as a spectacle.

THE FIRST TWO FIRES AT THE WORLD'S COLUMBIAN EXPOSITION.

The World's Columbian Exposition has for one of its chief purposes the education of those who attend it, and during the past week it has furnished two excellent object lessons of a sort which its promoters never intended. Twice during that time a crowd of many thousands have had a chance to see with what lightning-like rapidity a building constructed on the lath-and-plaster plan can be converted into a seething mass of flames.

The first fire of importance at the Exposition occurred at about 3 p. m. on Friday, July 7, in one of the "World's Fair hotels" which have sprung up like mushrooms all around Jackson Park. Being built in most cases on slender capital, and with small prospect of permanent use after the Fair is over, the flimsiest construction possible has been the rule. One of these fire-traps, located near the Illinois Central Railroad tracks, had an extension on its rear under which shavings and rubbish had been thrown. A spark from a passing engine began the mischief, and notwithstanding the fact that the fire started at a time when the building was almost entirely unoccupied the spread of the flames was so rapid that two people jumped from windows to escape the flames, Had the fire started in the night the list of victims would have been a long one.

The second fire, whose fatal results have been widely heralded by the newspapers, started on Monday, July 10, at 1 p. m., at the top of the high tower on the Cold Storage Building. The structure was about 40 ft. high, covering an area about 200 x 250 ft., with a flat roof and an ornamental tall tower some 200 ft. high in all rising from the center, inclosing and concealing an iron chimney stack. According to common report this lath-and-plaster tower was built around the iron stack with an air space between the two of only a few inches in some places. Moreover, the tower extended higher than the chimney stack, and it is said that it had been on fire twice before.

When the alarm was rung in on July 10 only a small blaze at the top of the tower was to be seen. The firemen ascended to the flat roof of the main building, but at that height the streams from their hose were not powerful enough to reach far up the tower, so a score or more ascended the tower to fight the flames from above. They had hardly done so when the flames burst out all around the base of the tower, and their escape was cut off. The burning of the flimsy structure was marvelously rapid. The poor fellows, crowded on a narrow ledge some 80 ft. above the flat roof, had barely time to realize their position before the flames were scorching them. One after another leaped to the roof below, and while some were still clinging to the tower the whole blazing mass careened, broke in two at its center and fell.

Then was seen a vivid illustration of the rapidity with which fire can spread in a building of such tinderbox construction. Hardly had the great crowd that watched the flames sent up an awe-stricken groan at the sight of the falling tower when the whole building, which had till then seemed to be untouched by the fire, sent forth clouds of smoke from every crack in its cornice. Almost instantly the flames followed, and the men who had been fighting the flames from the flat roof fled for their lives to the ladder, the last one creeping down it through a mass of flame.

That ended the sacrifice of lives, but for hours the fire had free sway in the structure, and the streams from more than 40 engines seemed to have no effect whatever in checking them. The building contained two Hercules ice machines in its basement, and was divided into rooms for cold storage purposes. The top story was one large room designed to be used as a skating rink, and the floor was covered at the time of the fire with several inches of water, which, however, appeared to have no effect whatever in checking the flames.

A detailed discussion of the causes of the fire would be out of place until more extended facts are at hand; but from what is at present known it would appear that the current criticism that artists, and not engineers, have had the chief voice in planning the exposition is not far out of place, particularly in regard to the minor buildings.

We trust, however, that two specific lessons at least will be learned from this last appalling disaster. The first and most important is either to close the roof promenade of the Manufactures Building to visitors or else provide stairway descents from it at two or three widely separated points, independent of the elevators and for use only in case of fire, or rope-ladder descents at many points on the outside of the roof. At the present moment there is but one method of ingress or egress from that delightful promenade, a narrow and contracted passageway leading to the hanging platform to which the elevators run, straight from the ground floor, through which passageway there is generally a strong upward draft, even without a fire to aid it.

At the first alarm of fire all the hundreds of visitors who are usually lounging about this half-mile promenade would rush for this small entrance, which will hardly pass two abreast, and leads only to elevators of ordinary size. Before any considerable fire could get under way in any part of the great interior, smoke would begin to pour out through this opening, fill the space about the hanging platform, and create the impression that the whole interior was on fire. The result could not but be a panic with terrible results, all of which can be avoided by providing rope ladders in abundance, or any other suitable provision for descending at a number of points along the outside of the roof if necessary. The second precaution against fire which is imperatively demanded is some slight provision for putting out the beginnings of a fire in every one of the "buckets" or cars of the Ferris wheel. That wheel seems to be in every other respect a perfectly safe structure, and fire in any of the buckets is most unlikely, but the interiors of the buckets are of wood, and each carries 38 passengers seated, some of whom will smoke or light matches in spite of regulations. The consequence of any fire or fire panic in these buckets would be so terrible, and the cost of providing against it so trifling, that provision ought to be made for it, remote as the chance is. We mention these two possible dangers in this public way because we fancy these are not the only places where a few greater precautions against fire panics might be studied to advantage, and these two at least demand prompt correction.

As the Krag-Jorgensen magazine rifle is now adopted for the use of the United States Army the question of cartridges for it assumes importance. While new machinery is being made for producing this rifle, the present capacity of the Springfield armory is about 1,000 per month, and one regiment is to be armed at a time with the new weapon. The proposed propelling powder is of the smokeless type, but as American experiments with this powder have not yet proved satisfactory the Belgian Wetteren powder will be used at first—the same that was used in the late official test of magazine guns. The bullet will be plated with nickel-steel, .30 caliber. With smokeless powder this projectile, weighing 200 grs., will have a velocity of about 2,000 ft.sec., as contrasted with the old .45-caliber, single loader of 500 grs., with a velocity of about 1,300 ft. sec. This increased velocity means a flat trajectory, so that if the soldier is lying on the ground the bullet will rise only about 4 ft. in a 500-yd. range. With the old bullet and low velocity the rise was three times as much, and the ball would pass over the heads of men 250 yds. away. The new powder makes the whole range dangerous to an enemy.

The contract for the Washington Bridge across the Housatonic River, between Milford and Stratford, Conn., has been awarded to Dean & Westbrook, of New York city. The bridge will consist of a swing span of 203 ft. and two fixed spans of 232 ft. each, resting on masonry piers on caissons on pile foundations. The center pier will be 22 ft. in diameter. The bridge will carry an 18-ft. roadway.

Tests of the nickel-steel armor for the monitor "Monadnock" and the battleship "Indiana," made at the Indian Head Naval Ordinance Proving Grounds on July 11, showed very satisfactory results. The first test was of a 9-in. plate, 6 ft. 4 ins. wide and 9 ft. 7 ins. long—a sample of the side armor of the monitor "Monadnock." It was nickel-steel, weighed ten tons, and was made by Carnegie, Phipps & Co., of Pittsburg. Three Holtzer projectiles, weighing 250 lbs. each, were fired against it from an 8-in. rifle, the muzzle being 58 ft. from the face of the target. The first projectile had a velocity of 1,400 ft. a second at the moment of impact, and penetrated the plate and oak backing to a depth of 11.7 ins. The second projectile, with a velocity of 1,683 ft., went through the plate and 3 ft. of oak backing, and lost itself in the earth against which the butt was built. The third projectile had a velocity of 1,536 ft., and penetrated plate and backing to a depth of 14½ ins. The plate withstood the strain of the attack well, no cracks being perceptible, and it fully met every requirement for acceptance.

The second plate was a sample of the curved plates for the barbette on the "Indiana," made by the Bethlehem Iron & Steel Co., and, like the first, of nickel-steel. Its dimensions were 8 ft. 4 ins. in height, 12 ft. 1 in. in length and 17 ins. in thickness and weighing 31½ lbs. It was subjected to attack from a 12-in. rifle which threw a Carpenter shell weighing 850 lbs. Its muzzle was 319 ft. from the face of the plate. The striking velocity of the first shot was 1,322 ft. a second, and it penetrated to a depth of 16.6 ins., lacking less than half an inch of going through. The second shot was fired with a velocity of 1,495 ft. a second and went 3 ins. into the oak backing. The third and last shot was to determine whether or not the premium was to be paid, and the velocity was raised to 1,858 ft. a second. When the smoke and dust following the discharge had lifted, it was found that the shell went clear through the plate and 36 ins. of oak backing, and the earth embankment into the river some hundred yards away. The plate secured for its makers the acceptance of the whole contract amounting to from 500 to 700 tons, but earned no premimum. Like the Monadnock plate, it showed no cracks under the terrific strain to which it had been subjected.

Even more satisfactory than the showing made by the plates was that of the projectiles. The 8-in. shells were of the Holtzer conical pattern, and the 12-in. ones of the Carpenter conical pattern. All four of the shells that were recovered appeared wholly unchanged, and the gage showed that they were disturbed to such a small degree that they might again be fired with the attachment of a new strip of rifling. Among those who witnessed the tests were Secretary of the Navy Herbert, representatives of the contracting companies, Capt. Ord Brown, the famous English ordnance expert, and M. Bouvard, superintendent of the armor department of the Cruzot Works, France.

LETTERS TO THE EDITOR.

SPIKES AND RAIL FASTENINGS.

Sir: An old mechanic once remarked to me, referring to an error in a drawing he was working by, "that if anything appeared incorrect by sight, invariably it was so." This was his method of "checking," in which he depended upon his experience, combined with common-sense. If this old mechanic were to visit the Columbian Exposition at Chicago and see an exhibit of standard track, with 100-lb. rails, fastened to wood ties with five or six-inch "nails," I venture to suggest he would say that was incorrect, or should his engineer tell him he was under an "optical illusion" he would probably answer he had heard of such a thing, but knew better.

The purpose of this note is to draw your attention to the present method of fastening (?) rails to ties. It may be advanced that it is based on the accumulated experience of hundreds of engineers and years of study in this country, but one does not have to look far afield for a better state of things. It is not necessary for us to adopt a "chair" for rails, a better rest is already provided; but no one will deny that the spike alone is an unsatisfactory fastening. If he does, let him look at the exhibit above spoken of and then go to the Transportation Building and look at the New South Wales track fastening, where "security" is invisibly written on the exhibit. If it is not satisfactory to the old fogy, and he is still unconvinced, let him shake off his old-fogyism and look at some of the track in this varied country, where examples of the failure of the spike are abundant. Indeed, the most marvelous feature of railroading to me is, that the trains stay on the track. By way of illustration: A man of my acquaintance was running a preliminary line and part parallelled a railway. At an angle point which intersected in the middle of a macadamized road, he could not drive a stake, but sent his man to the track where the spikes were mostly out and loose alongside of the track to obtain one!!

I hope this letter will bring forth some reason (?) from those who champion the once useful, but now outgrown, " tin-tack " fastening why its use should be continued. Yours truly, R. A. C.

Baltimore, Md., July 10, 1893.

(We think there can be no doubt that the spike must go. Well as it has done its work in earlier days, and with lighter rails and rolling stock, it has been outgrown by track laid with 80-lb. to 100-lb. rails and carrying the enormous weights of modern locomotives and trains. That this is so can be seen by the loose fastenings which are so frequent on otherwise good tracks of important railways, as was pointed out in an article on "The Relations of Track to Train Service" in our issue of June 15. Various forms of improved rail fastenings have been designed, but just what is the best type we are not now prepared to state, but it seems inevitable that the spike must of necessity be superseded on heavy tracks for heavy traffic.—Ed.)

SPECIAL BONDING BRICKS IN ARCH WORK.

Sir: In looking over the interesting article entitled "New Tunnel on the London & Northwestern Railway," which appeared in your issue of June 29, page 603, I noticed an allusion to the bonding bricks, of which there are five courses in the arch. Is this practice not an innovation? The reason I ask is, I have in mind a tunnel lately built on an important line, in the brick arching of which the engineer positively prohibited the use of bonding bricks, the contractor on the contrary being strongly in favor of the arrangement. I would be glad to have the experience of your readers on this point. Tunnel.

(These bonding brick are novel to us in American practice, and we cannot find that they are at all common in English practice. The effect of the bonding brick is to practically divide the arch into great voussoirs and to somewhat reduce the thickness of the mortar joints in the extrados of each voussoir, and this should be beneficial to the arch. One of the best pieces of American arch work coming under our observation carried this practice even to a greater length in a segmental arch span of 55 ft., by making a distinct voussoir of every eight bricks on the intrados, and laying these face bricks in "header and stretcher" fashion. The joints for each of these long voussoirs were made truly radial by a "radius square" and the bricks in this section were so laid that there were nine bricks in the extrados of each voussoir, thus greatly reducing the outer mortar joints. The purpose of the builder was to reduce the width of outer mortar joints and to eliminate the danger of gaping intrados joints, due to any settlement at the crown, and in this he was very successful. These arches were on piles in somewhat uncertain ground, and behaved very well under a perceptible sinking at the crown.—Ed.)

THE SYRIA-OTTOMAN RAILWAY.

Sir: I have read with much interest your article in No. 19 of Engineering News dealing with our railway scheme from here to Damascus, and it is the first time I have seen it mentioned in a home paper. As fellow-citizens it may interest your readers to know that I am the company's resident engineer in Syria and have control over the execution of the work.

By referring to works written by me and published by the English and German Palestine Exploring Societies ("Across the Jordan," "The Janlan and Ajlun, or Within the Decapolis Pella," "Abila," etc., sold at 24 Hanover Square, London, and at Leipsic, at Baedecker's Buch-handlung) you will see that I had already surveyed this line in 1882-83, and had mapped the country of Janlan, Hauran and Ajlun (Gilead), and was thus the pioneer of the scheme which is now being executed in conformity with my original plans.

As mentioned in your article the profile of the line is very peculiar, owing to the depression of the Jordan valley, and it is the only railway line in the world crossing a territory 900 ft. below sea-level. The grades into and out of this valley are to some extent steep but short, and the configuration of the country does not involve much work. The plains of Esdrelon and Jezreel are rich, and the high plateau of Hauran, the granary of Syria and crossed by the line, will doubtless be better utilized. Taking these resources, with the commerce of Damascus, the net revenues of the line seem very promising.

Works of this nature are destined to open up the wealth of this downtrodden country, and will doubtless bring to the light new and unexpected treasures. The government realizes this, and already manifests a lively interest in the enterprise and promises support. I wish that our country, the United States, could participate in the success.

We are pushing the work as fast as possible; five miles of the line are nearly completed, and by the beginning of next year we hope to take Palestine tourists down to the Jordan by rail.

G. Schumacher, U. S. Consular Agent.

Haifa, Palestine, June 15, 1893.

THE THEORY OF THE AIR-LIFT PUMP.

Sir: In your issue of June 8, while discussing the theory of the air-lift pump, you state that, under certain limited conditions, "it is certainly the case that the water will rise in the pipe."

You then ask (p. 541): "Can it be proved that the same thing will occur with bubbles of any size or number?"

Without going into any strict mathematical proof let me offer an explanation of the fact that the water will both commence to rise and continue to rise with air bubbles of any size or number under the conditions stated.

Suppose the tube A B (p. 541) to be full of water and air bubbles, and that we can keep the bubbles for a time from moving upward by some force—say—akin to magnetism. During this time we have static equilibrium, the downward pressure of the water at the lower end of the tube A B being equal to the upward pressure of the surrounding liquid.

Now let the force keeping the bubbles at rest be removed and they will immediately begin to rise, since the pressure from below is greater than the pressure on them form above. Some of them will reach the surface and escape from the tube. The surface of the water in the tube is immediately lowered, the static equilibrium is destroyed, the upward pressure on the lower end of the tube forces the water up the tube till it is level with that which surrounds it, motion commences, and any theory founded on static equilibrium must be discarded.

The bubbles will now rise in the tube with a velocity, due not only to the excess of pressure on their lower sides, but also to the upward motion of the water in the tube and will escape more rapidly and the water will rise with greater velocity, not only on this account, but because the upward pressure of the surrounding liquid is now only opposed by a lighter mixture of air and water, and also because the downward pressure of the water in the tube, which is now in motion, is lessened by the pressure corresponding to the motion.

Supposing now that air bubbles are constantly supplied at the foot of the tube A B, at a pressure sufficient to release them from the air supply tube, the water will continue to rise in the tube A B with accelerated velocity till what may be called dynamical equilibrium is reached, when the water will rise with uniform velocity, and, under proper conditions, will flow out of the top of the tube A B when it is much higher than the surrounding fluid. Yours truly,

H. Irwin,

Chief Engineer's Office, Can. Pac. Ry. Montreal, June 12, 1893.

THE AIR LIFT PUMP.

Sir: The article on the Pohle air lift pump opens a new field, or rather makes its opening better known. In the oil regions, in old "pit hole" times, the writer observed, wherever he could get data, that the pressures of gas or of oil and gas were closely in accordance with the difference in gravity between the columns and water columns of corresponding heights, and considered this the real cause of the flow. It would appear that nature has been aware of the principles involved in the Frizell or Pohle air lift for some time, and does not hesitate to make use of it at any depth.

What we want now are data regarding capacity. So far as I can see, in wells of small diameter, say 3 to 8 ins., it is not very different from the capacity of the single-acting pumps now used in such wells, but has the great advantage of raising the working parts all above ground.

I have found air and water under great pressure (8 to 10 atmospheres) to mix and appear like milk and have seen this mixture discharge from a hydrant without any explosive action. I therefore think that the minute subdivision of the air spoken of by Mr. Frizell will be pretty sure to occur when the device is used for great depths, and I think, too, that such use will be found as efficient, if not more so, than the limited lifts yet made.

G. W. Pearsons, M. Am. Soc. C. E.

Kansas City, Mo., July 3, 1893.

PENNSYLVANIA MARBLE.

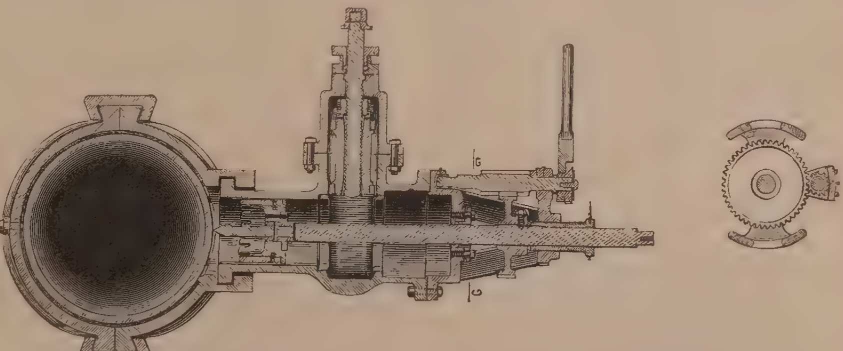
Sir: Under "Engineering News of the Week," p. 601, in your issue of June 29th, referring to our discovery of marble here, and giving some of the tests made by Prof. J. F. Kemp, of the Columbia College School of Mines, New York city, you say: "These figures are so exceptionally good as to make it seem doubtful if they are indexes of the general character of the rock." In reply we beg leave to state that the crushing strength of 22,510 lbs. per sq. in. was the maximum, but as the tests were made from cylindrical cores 1⅝ ins. diameter, drilled at an inclination to the grain of the stone and subject to the grinding of a steam acting diamond drill and rods, we did not think it unfair to quote the maximum result of the crushing tests. The absorption of 0.052 of 1% was the maximum absorption, and 0.0215 of 1% was the minimum. These tests approximated so very closely those made by Professor Koenig, Michigan Mining School, that we do not think that there can be any question about them. The original reports are in our possession, and the untested cores are now here—would be pleased to submit both to your inspection. Very truly yours,

Avondale Marble Co.,
Per R. H. Hepburn, President.

Avondale, Pa., July 1, 1893.

PIPE TAPPING AND CONNECTING DEVICE.

The inconveniences caused to water consumers by the shutting off of water for the purpose of making main connections and the advantages of making connections without shutting off water have led Mr. Anthony P. Smith, of Newark, N. J., to develop a tapping and connecting machine, by means of which a pipe may be tapped under pressure and a new main connected with an old, all without interfering with the water service.



SECTION THROUGH PIPE TOPPING AND CONNECTING APPARATUS.

The accompanying cut shows a section through one of these machines when attached to a street main for service. A sleeve and gate are attached to the water main, the outer end of the gate connection having the machine fastened to it. By means of a lever arm a central drill and tap first cut a hole in the center of the circular piece of pipe which is to be removed, after which a mandrel cuts out the disk. The disk and cutting apparatus are then run to a point outside the gate and the gate closed. The machine is then entirely removed, leaving the hub or bell end of the gate ready for connection with the new main, after which the gate may be opened and the new main put in use.

A substitute method of tapping may be employed by means of which the gate may be placed at a greater distance from the intersection, if desired.

Mr. Smith states that connections ranging from 2 to 48 ins. in size have been made with the aid of this machine. It is evident that a double connection can be made with one sleeve by having branches and gates for each half sleeve.

Some of the notable connections for which the machine has been used are the following:

A 10-in. connection was made with a 10-in. main in front of the high service pumping station, in Newark, N. J., with 80 lbs. pressure on the main that was being cut, and the large pumping engine running while the connection was being made. A 12-in. connection was made with one of the 36-in. mains supplying Jersey City, N. J., where it passes under the roadbed of the D., L. & W. R. R. The shell of this 36-in. main at this point is 2 ins. thick. Two 20-in. connections out of a 20-in. main were made under exacting circumstances at the Hackensack Water Co.'s reservoirs, Weehawken, N. J. The pipe was 30 ft. above the level of the ground, and the cut was performed at an angle of 45° out of the side of the main from a scaffold specially erected for the purpose. At Bull's Ferry branch road, a 16-in. connection was made out of a 16-in. main with a like satisfactory result.

In our issues of Jan. 24 and Aug. 15, 1891, we described and illustrated a pipe tapping machine very similar to that described above, which we have since been informed was an infringement on Mr. Smith's patents.

CONSTRUCTION OF JETTIES AT YAQUINA BAY, OREGON.

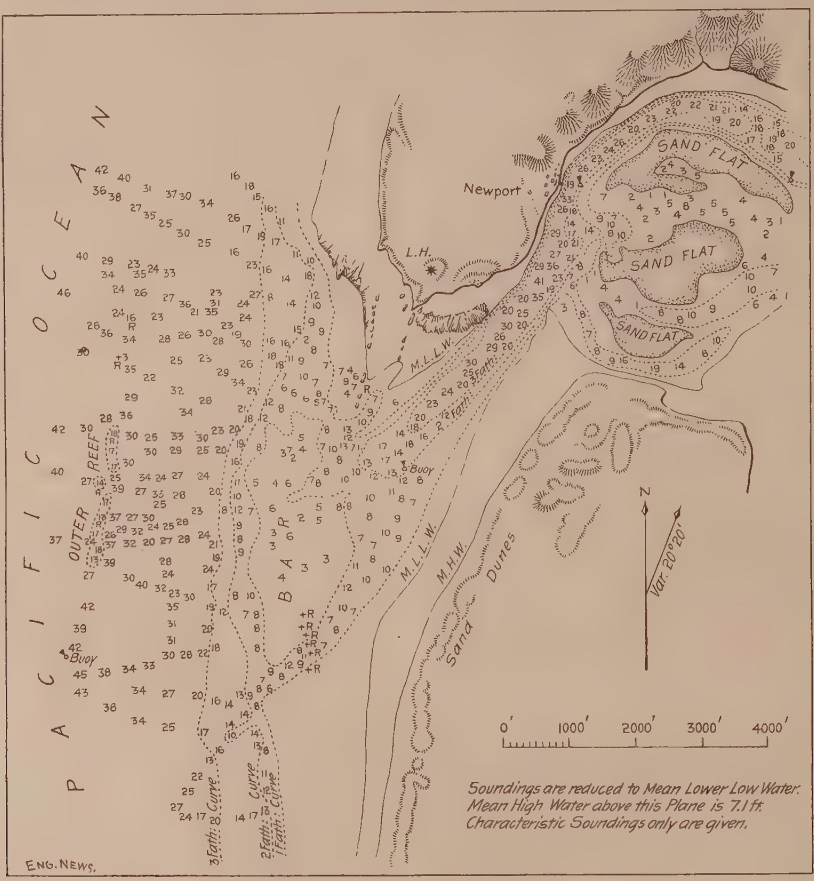
By Gwynn A. Lyell, formerly Assistant Engineer in Charge.

The entrance to Yaquina Bay, Oregon, is in latitude 44° 41′ north, and longitude 124° 05′ west, approximately. A rocky headland projects on the north side and on the south side of the entrance low sand dunes stretch away as far as the eye can reach, and the beach is very flat. Southerly gales deposited sand from this beach into the river, which was borne out by strong currents and deposited again by incoming tides. The bar extended north and south for nearly a mile, but was narrow. The plan, from the U. S. Engineer Survey of August, 1880, shows the entrance prior to improvement work.

Two channels of uncertain depth existed; one at the north, and the other at the south side of the entrance. The approach to the north channel was rocky, and seldom or never used. The south channel could be approached from an open sea, but once in it there were dangerous rocks projecting to be avoided, besides the beach was very close on the starboard side. The least depth on the bar proper, prior to improvement, was just 2 ft. The south channel had a least depth of 7 ft. at low water. The surf is usually very heavy along the coast, and immense quantities of sand are displaced with every rise of the tide. The heavy storms commence in October, but the severest occur in January. A good idea of rough seas on the Pacific coast, may be conceived from the fact that during a gale in 1881, at Tillamook Rock Lighthouse, 88 miles up the coast, pieces of stone weighing over 20 lbs. were cast by the sea onto the roof of the lightkeeper's dwelling, about 100 ft. above sea level. The writer has himself observed, during storms at Yaquina Bay, breakers on the reef in 12 to 24 ft. of water, and spray dashed fully 50 ft. in the air.

A natural protection to the Yaquina entrance is a long reef of submerged rocks lying nearly a mile off shore, with 12 to 24 ft. of water over it at low tide. This reef breaks the force of the waves during stormy weather from the northwest, and was also a governing factor in the location and trace of the jetties. Just inside the entrance the channel is deflected in a southerly direction by the obstructing sands and the rocky head land on the north making the navigable channel at the south side.

Newport, a small town, is located on the right shore of the bay, about a mile inside the entrance. Yaquina city, a small settlement, is also on the same side of the bay, about four miles from Newport, and is now the western terminus of the Oregon Pacific Railroad. Yaquina River is a small stream which rises in the coast range of mountains, and enters tidewater about 22 miles from the ocean. The portion of the bay under tidal influence has an area of about five square miles. The average rise of the tides above the established plane of reference is 7.1 ft., 11 ft. being the extreme range of the tides from the lowest to highest. The mean ebb discharge is about 38,000 cu. ft. per second, depending upon the map and spring tides. The lower five miles of the bay carry 18 to 30 ft. at low tide in a channel most of the way 400 ft. wide, more or less, between its lateral 18-ft. contours, and for part of the way in less width.



Soundings are reduced to Mean Lower Low Water. Mean High Water above this Plane is 7.1 ft. Characteristic Soundings only are given.

ENTRANCE TO YAQUINA BAY, OREGON, ON AUG. 1880, PRECEDING WORK OF IMPROVEMENT.

There is a remarkable variation in the rise and fall of tides on the Pacific Coast, the lesser tides occurring generally along the southern coast, increasing in volume northward. On the Oregon coast, commencing at Coquille River, near the southern boundary, the mean rise of the tide is 4 ft.; proceeding north, at Coos Bay, the mean rise is 5.6 ft.; at Siuslaw River, farther north, it is about 5.5 ft., and at Yaquina Bay it is 7 ft. At several points on Puget Sound the mean rise of tides is about 16 ft. A peculiarity of the tides exists in the fact that there are in every 24 hours nearly two high and two low tides; or, as they are termed a "higher high," "lower high," "higher low," and "lower low" tides, ranging in the following order: From the "higher high" tide the water falls to the lower of the two low tides, then rises to the lower of the two high tides, then falls to the higher of the two low tides, then rises again to the higher of the two high tides. Sometimes a "stand" occurs, that is, there is no appreciable difference between the "lower high" and the "higher low" waters, resulting in slack water for several hours.

On June 14, 1880, the sum of $40,000 was appropriated by Act of Congress for the purpose of commencing improvement work. Maj. G. L. Gillespie, Corps of Engineers, U. S. Army, had charge of the district in which Yaquina Bay is located, and under his direction a survey of the entrance was made by Mr. J. S. Polhemus, Assistant Engineer, August, 1880, preparatory to location of proposed jetties. A careful study was made of the chart, tides, currents and shore line north and south of the entrance. The outlying rocks to the northward rendered it impracticable to open a channel there and similar obstructions existed to the southward. Navigating the south channel was always attended with danger on account of its proximity to the beach, and broadside exposure of a vessel in the trough of the sea. The central channel contained apparently no obstructions other than the sand bar overlying the ledge, the depth of which below the plane of reference could not be ascertained at the time of the survey, on account of the roughness of the bar. It was therefore decided, considering the available data, to start the south jetty and thereby close the south channel; this would deflect the outgoing current toward the bar, where it was wanted to scour off the sand and eventually make that the navigable channel.

The estimated cost of the project was $465,000 and contemplated the construction on the south side of a "short jetty of timber cribs filled with stone, or of brush mattresses ballasted with stone, so directed that the outgoing waters would be deflected toward the central channel away from the rocky south channel with a view to scouring off the sand." The plan adopted for the south jetty was to start at the shore with stone and mattress work and carry it so constructed to the 7-ft. curve, with a base of 60 ft. and width on top of 20 ft.; and from the 7-ft. curve outward timber cribs were to be placed filled with stone, with widths varying from 20 to 25 ft., according to the depths. This jetty was to be 2,500 ft. long, and built up 2 ft. above mean low water.

The inaccessibility of the locality by land and sea, and the small amount available for commencing such a piece of work, rendered it impracticable to let the work by contract. In fact, proposals were received but found unsatisfactory. March, 1881, found the preliminary work under way, and two scows for the transporting rock were built. A quarry was opened about 14 miles up the river, this being the nearest point at which suitable rock could be quarried. The stone was a coarse grained sand stone of good quality, weighing about 140 lbs. to the cubic foot.

In June following the first crib was successfully sunk on the alinement of the jetty and 150 cu. yds. of stone dumped into it. This work was attended with many difficulties owing to rough water, and could be done only at ebb or slack water. Rock could be placed in the cribs only from the deck of a scow which, in the rough water, and insecure moorings, could not be kept from thumping against the crib. A storm came up and the heavy surf caused the partially filled crib to careen and lose ballast; it floated off and came ashore. Other attempts were made to sink cribs on the jetty alinements, but without success, and this part of the project was abandoned.

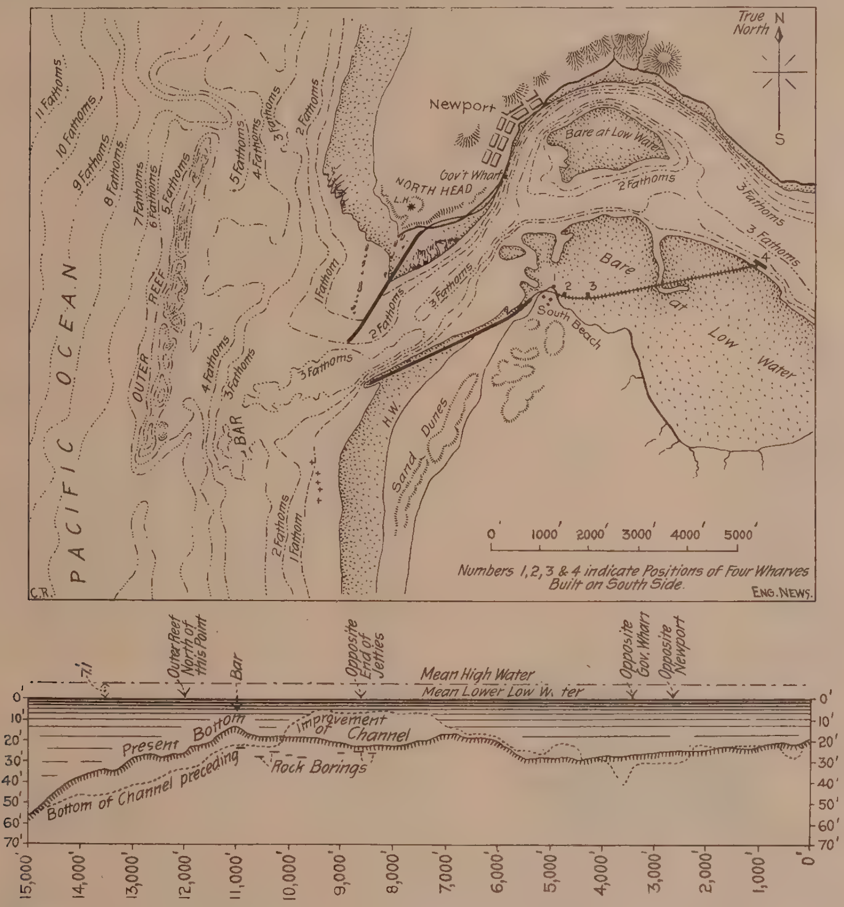
The cribs were 25 ft. wide, 48 ft. long, 23 courses high, timbers 12 × 12-in. Oregon fir. They were dovetailed with solid outside walls, bolted with 1⅛-in. round iron; the bottom of the crib was a grillage with openings of 2 ft. 6 ins. by 2 ft. 10 ins. The failure of the cribwork necessitated the construction of a receiving wharf upon which to land the rock. This was built on the south, inside the bay, and a hoisting engine and derrick placed on it. A single track tramway was built on light timbers with a plank walkway out to the intended root of the jetty. A few small dump cars were procured; these with a pair of mules constituted the motive power to start with. The top of tramway at the start was 14 ft. above mean low water. The jetty was commenced at the high water mark. Small piles were driven by hand, capped, and the track kept ahead of the mattress work. A foundation mattress 60 ft. wide and 2 ft. thick was weighted down with a covering of a foot or more of stone, and on top of this another mattress 30 ft. wide was placed, and the whole riprapped with stone.

The mattresses were made by crossing two thicknesses of fascines 1 ft. in diameter, bound together between two grillages made of fir poles about 6 ins. in diameter. During the season 550 ft. of jetty were built. In the fall of 1881 severe storms occurred, and some of the rock was displaced; heavy surf swept over the outer end of jetty, but the superstructure was not injured. In December, 1881, all work was suspended, the appropriation having been exhausted. Up to this time $50,000 had been expended on the improvement.

North Jetty.

Aug. 2, 1882, Congress appropriated $60,000 for the work, and the following fall work was resumed. The work already done was effective on the bar, the depth of water having increased to 10 ft. at low tide and sand had begun to fill the dangerous south channel, and was banked upon the south side of jetty, thereby protecting it. The low water line had advanced seaward 1,000 ft. During the season of 1882-83 the jetty was advanced in a partially finished state 1,380 ft. The piles were pumped into the sand by a jet from a steam pump. The beneficial effect of the jetty work stimulated the projectors of a railway between Yacquina Bay and Corvallis, in the Willamette Valley, and construction work was pushed.

The fourth appropriation, of $50,000, was made July 5, 1884, work having been suspended for nearly a year. A break had been made in the incompleted jetty by the heavy seas washing over it near the inshore end. Sand had banked on the south side out to the end of the jetty; some scouring had been done on the channel side, and the channel had been shifted a little to the south. With the last appropriation the jetty reached a total length of 2,042 ft. and work progressed much slower as deeper water was reached, rendering the prosecution of work more difficult and expensive.



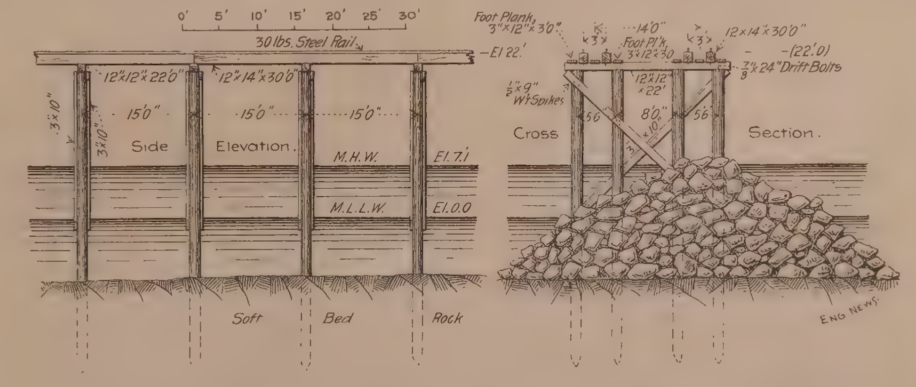
ENTRANCE TO YAQUINA BAY, OREGON, 1891; AND LONGITUDINAL PROFILE SHOWING PRESENT AND ORIGINAL CONDITIONS.

The channel was located and sounded in May, 1884, and showed a least depth of 12 ft. at the plane of reference, or 19 ft. at high tide. At this time, owing to the advanced stage of the railway construction, and the continued favorable condition of the bar, the Oregon Development Co. placed an iron steamer on the route between San Francisco and Yaquina Bay; her draft was 12 ft., loaded; capacity, 1,200 tons.

June 10, 1885, the work was again suspended, as the appropriation was about exhausted. At this time the jetty had a total length of 2,517 ft., and new pile bents had been placed the entire length, and the height of new tramway increased to 21½ ft. above low water. A spur jetty had been thrown out near the inshore end of main jetty to counteract the scouring effect of strong currents developed by the flood tide.

A revolving pile-driver with a reach of 20 ft. was constructed during the season (1885) and used in the extension of the new tramway. This driver was mounted on four ordinary 4-wheel trucks, operated on a double track. On top of the truck frame was placed a circular track upon which a turntable revolved. The turntable carried the upper framework, to which the hammer guides were fastened, and at the opposite end a hoisting engine for manipulating the hammer and piles was placed, so that one end counterbalanced the other. Circular motion was given the driver by means of a pinion, which engaged in a concentric gearing. The pinion was keyed on a vertical shaft, to which was attached a long lever operated by two men.

Following the suspension of operations in 1885, a careful hydrographic survey was made of the entrance, and 47 borings were made on the bar to ascertain if possible the depth to the underlying rock. The least depth was found to be 18 ft. below the plane of reference. The borings were made from a tug anchored on the bar, and its position for each boring located. A section of 1¼-in. pipe was attached by a piece of hose to a No. 4 Blake pump, and worked down to the rock. This work could only be done in calm weather. The main channel still trended toward the south, and the south channel was almost obliterated. The north channel was wider and deeper. A comparison of the 1885 survey with that of 1880 showed a movement seaward of the sands, and a shifting of the middle sands from a north and south range to one parallel with the jetty. Stronger currents were developed by the slight contraction given the entrance by the south jetty. The scouring effect of flood tide currents was always greater than that produced by the ebb tides along the jetty wall, since the flood tide was always accompanied by heavy swells which raced along the jetty wall, washing out sand and causing the rocks to take a flatter slope than that given by dumping from the cars. This proved afterward a benefit to the jetty, as it allowed heavy breakers to pass over the jetty without injury to it.



LONGITUDINAL ELEVATION AND CROSS SECTION OF NORTH JETTY AND TRAMWAY; YAQUINA BAY, OREGON.

In 1885 the Oregon Pacific Railroad was completed from Yaquina Bay to Corvallis, 72 miles distant, and a part of the wheat crop of that season from the Willamette Valley was exported via the Yaquina route to San Francisco. This was regarded as a great achievement, as it afforded the Willamette Valley producers a market at San Francisco in competition with Portland, reducing freight rates and making a saving in time over existing routes of two days, or, in distance, of 250 miles.

Aug. 5, 1886, $75,000 was appropriated by Congress for continuing the work and estimates were made for extending the south jetty, and also for commencing work on the north side of the entrance. The surveys of 1885-6 showed that the 12 and 18-ft. curves had been pushed out 900 and 1,400 ft., respectively, while the channel depths had not changed. The low water line opposite the south rocks had receded some 300 ft. At the jetty end it had moved out, and also along the channel side of jetty. In 1880 the face of the bar was straight and parallel with outer reef and general shore line. The jetty forced the sands seaward, causing the face of the bar to take a convex shape toward the reef, by an advance of the middle part, the sides receding. A section at the gorge showed a central depth at low water, of 32 ft. and mean depth of 8.6 ft., with widths at high and low tide and at depths of 15 ft. or more of 1,940, 1,140 and 420 ft., respectively. Mean ebb velocities through gorge at entrance were 2.01 and 2.43 ft. per second. Current measurements were taken outside the entrance, but as these were nearly always affected by the wind, in one direction or another, no particular value could be attached to information derived from them.

A project was submitted by Capt. C. F. Powell, Corps of Engineers, April 6, 1887, for a jetty on the north side of entrance. This jetty would close the north channel, through which a large part of the tidal waters passed. Captain Powell stated in his project that the time had arrived when such an improvement to the entrance as would permit foreign grain ships to cross out when loaded, seemed to be most urgently demanded. Work was again suspended.

Aug. 11, 1888, Congress appropriated $150,000 for continuing the work, and operations were resumed the 20th of the same month. Nov. 13, 1888, a board of engineer officers, consisting of Col. G. H. Mendell, Maj. W. A. Jones and Maj. T. H. Handbury, convened in Portland, Ore., to formulate a plan for continuing the work. The locality was visited by the board, and the following project adopted:

To raise the south jetty to full high tide without extending it seaward, thus making its total length 3,748 ft., and to construct a midtide jetty on the north side of the entrance, about 2,000 ft. in length extending from the north head along and behind the reef, putting out from the head to a point opposite the end of the south jetty, and distant from it about 1,000 ft. Their report further says that the benefit secured consists in increased depth and a less variable condition in alinement and depth of channel. The mean depth has been 13 ft., in place of the natural and original depth of 9 ft. or less. The exterior 12 and 18-ft. contours are now about 500 ft. beyond their position in 1880, before the work was commenced. The inner contours have, however, advanced yet more, so that the width of the bar between the 12-ft. contours has been lessened to the extent of about 900 ft. The exterior 18-ft. contour of the bar has approached the reef, being now about 1,300 ft. distant. These results represent the effect of the jetty as it now (November, 1888) stands.

Work on the north side was commenced in December, 1888, by building a wharf, 62 × 132 ft., at Newport and starting from it a tramway at an elevation of 22 ft. above datum. On this side a rock bottom was encountered for over 2,000 ft., and a great many of the piles had to be set by hand. In June, 1889, a survey of the entrance showed a least depth of 14 ft. at low water, with a straight channel, nearly parallel with the south jetty. At this date the south jetty was completed and the north jetty was 300 ft. long. But to further protect the south jetty and to allow for flattening and settlement, the enrockment was carried to full high tide mark for nearly its entire length. At the close of the season, October, 1889, the north jetty was 1,180 ft. long, and the enrockment was carried to midtide.

The cross-section of the north jetty was smaller than that on the south side, as the bottom was a soft rock with very little sand overlying it. This rock was a bluish tough, soapy stone, which hardened on exposure to the atmosphere. The tramway approach to the north jetty was built on four-pile bents 10 ft. apart. The piles were capped with 10 × 12-in. timbers 22 ft. long. Track stringers were 12 × 12 ins., 20 ft. long, and carried the rails. The bents were sway-braced with 3 × 9-in. plank. The jetty tramway was made for double track, 14 ft. between track centers. The bents were 12 ft. apart at the inner end of the jetty, for about the first 1,000 ft. For the remaining distance the bents were placed 15 ft. between centres. The caps were 12 × 12 ins., track stringers 12 × 14 ins., 30 ft. long; sway-braces, 3 × 10 ins. The rails were of steel .30 lbs. per yd.

On Nov. 12, 1890, the writer assumed local charge of the work. Very little work had been done since November, 1889, and Congress appropriated $165,000 for continuing the work September, 1890. Work was resumed Oct. 1, but was not fairly under way until the middle of November. The end of the north jetty was about 3,000 ft. from the receiving wharf, and sand was accumulating fast on the north side of the jetty and followed it out. The south jetty had settled about 3 ft. at the outer end, and heavy seas had washed a gap through the protecting spur. By June, 1891, the north jetty was 4,000 ft. long and a complete survey made of the bar showed 11 ft. at low water, with a perfectly straight channel, and a short bar. The inner north shore abreast of the jetty was scoured clean of sand. Along the nose of the jetty, each side, the low-water line had advanced seaward 450 ft. From the high-water line inshore sand had piled to the top of the enrockment covering it in most places. At the south side sand tailed out past the end of the jetty, and on the flood tide was carried midway between the two jetties and there deposited as a middle ground. On the ebb this sand was taken up again and deposited on the bar.

The extension of the north jetty demonstrated very clearly that the south jetty should be further extended to deep water, to destroy the effect of a strong counter-current, and at the same time prolong the effect of the ebb tide. This would also cut out the middle ground that formed abreast of the end of south jetty. In October, 1891, the least depth reported by the bar tug was 14 ft. at low water; this was 2 ft. in excess of what was expected of the improvement.

For the first 2,000 ft. of the north jetty pile-driving was attended with no difficulty. In the soft rock an average depth of 8 ft. 9 ins. was reached. The piles were simply pointed on four sides, showing a section at the point 4 × 6 ins. The tops were squared and the edges chamfered all round; this with the concave face of hammer prevented brooming. The piles were 40 to 50 ft. long. Average fall of 3,600-lb. hammer was about 12 ft.; blows were delivered in quick succession; penetration each blow was 2¼ ins., and penetration of last five or six blows was ½ in. A rocky ledge was reached after passing over 2,000 ft., into which it was impossible to effect an entrance with piles shod with iron, and they were simply placed on the rock settled to place with the hammer, capped and braced, and rock was hurriedly placed about the bents; in this way about 400 ft. of tramway was safely passed over. During the season of 1891-92 several bents of completed tramway were swept away by heavy seas, the piles not having been sufficiently ripraped to protect them.

Up to June 30, 1892, a total of about 80,000 tons of rock had been dumped on the north jetty, and the tramway was completed to a point opposite and 1,000 ft. from the south jetty, thus completing the tramway in accordance with the project of the board of engineers of Nov. 13, 1888. Plate IV. shows the last survey made of the entrance. The south jetty was further strengthened in 1892, and a total of about 100,000 tons of rock dumped on it. During the winter of 1891-2, 15 ft. of water on the bar was frequently reported by the bar tug and passing steamers; and in the spring of 1892 there was 16 ft. at low tide, and occasionally 18 ft. was reported. Up to the present time, May, 1893, something over $600,000 has been expended on the Yaquina Bay jetties, $635,000 having been appropriated for the work. A final appropriation of $75,000 has been asked for, to complete the work in accordance with the recommendation of the Board of Engineers of Nov. 13, 1888.

Revolving Pile Driver; Yaquina Bay Jetties.

The Yaquina jetties in an unfinished state have more than fulfilled the conditions required of them, by maintaining an almost straight channel 14 ft. deep at low water, where originally only 7 ft. existed, and it is believed that 18 ft. will be the ruling depth after another season's work shall have been done. It now remains to be seen how long these jetties can withstand the storms and rough seas to which they will be subjected. Originally projected as midtide jetties they have been built up to high tide, to allow for settlement and flattening. To make them permanent it will no doubt be necessary after a few years to place on their flattened tops masses or blocks of concrete, so disposed that the finished top of jetty shall not be above high tide, and thus allow heavy seas to pass over and not beat against the jetty. The plant on hand is an expensive one and constantly subjected to the deteriorating effect of salt air, and consists of the following material: Two 5-ton locomotives, forty 8-ton dump cars, 8 hoisting engines, two 15-ton derricks, 3 floating derricks for quarry, fourteen 270-ton rock scows, 1 revolving pile-driver, 1 naphtha launch, complete quarry outfit, blacksmith's tools, forges, tackle, rowboats, etc.

The materials of construction and cost of same may be given as follows: Piles, 30 to 50 ft. long, per ft., 6 to 8 cts.; fir lumber, $10 to $12 per M; round iron, 3 cts. per lb.; rock placed on jetty, 82 cts. to $1.18 per ton of 2,000 lbs.; double track tramway, north side, per ft., $4.76; cost of double track tramway per ft., south side, $8.54; single track tramway per ft., piles driven with floating driver inside the bay, $2.52.

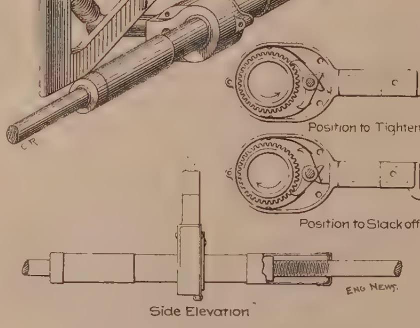
The total length of jetties, including shore protection, is: North jetty, 2,700 ft.; south jetty, 4,300 ft.; total, 7,000 ft., at a total cost of about $90 per lin. ft. This includes cost of mess, and bunk houses, blacksmith shops, car shops, wharves and landings, miscellaneous tools, water supply, surveying, superintendence, etc. The following United States engineer officers have had charge of the district in which the work at Yaquina Bay is located: Maj. G. L. Gillespie, Captains C. F. Powell, W. Young and T. W. Symons, with the following civil engineers as assistants in local charge, in the order named: Messrs. J. S. Polhemus, G. A. Lyell, E. Ricksecker, Lieut. G. D. Fitch, Corps of Engineers, and J. G. Holcombe, the latter now in charge.

THE HINCKLEY AUTOMATIC BRAKE-SLACK ADJUSTER.

In an article on automatic brake-slack adjusters in our issue of June 8 we unfortunately, through a misunderstanding of this office, did an injustice to the Hinckley Brake Co., of Trenton, N. J., by illustrating an early form of the Hinckley automatic adjuster instead of the improved form as now manufactured by this company. We therefore give this week a cut of the improved pattern, with description of its operation.

As stated in the issue above referred to, it is necessary, in order to insure efficiency in the operation of air-brakes, to take up the slack from time to time, as the brakeshoes wear, so that brakeshoes that are worn will be applied with practically the same pressure as that on unworn brakeshoes. If the slack is not adjusted, the brake piston may reach the end of its travel without properly applying the worn shoes to the wheels. The adjustment of the slack is one of the duties of car inspectors, but several devices have been invented for automatically adjusting the slack.

In the Hinckley automatic adjuster this is effected by a ratchet and pawls turning a sleeve or swivel with threads engaging with those on the ends of the rods. The ratchet and pawls are completely inclosed in a dust proof case formed in one piece with the operating lever, and the threads on the rods are also inclosed. Only one adjuster is required for each car, the ends of the rods being attached to the brake levers. In service the operating lever of the adjuster is held up to the edge of the triangular bracket by the spring. The upper pawl in the case engages with the teeth of the ratchet and is free to drag over the teeth when the lever is pulled down. Upon applying air, if the piston moves beyond its prescribed stroke this lever is sufficiently deflected by the bracket, against the edge of which it presses and moves, to allow the upper pawl to drop into another tooth of the ratchet. Upon releasing the brake the spring draws the lever back and up along the edge of the bracket, thus turning the swivel and shortening the rod. As this is done when the strain is off the rod there is no cutting wear of the threads. This operation is repeated until the piston has ceased to move too far, when the fulcrum rod does not carry



Hinckley Automatic Brake Slack Adjuster.

the lever of the adjuster sufficiently far under the bracket to deflect it enough to cause the upper pawl to gain a tooth, and consequently no shortening of the rod takes place. When new brakeshoes are to be put on, and slack is required, the hook of the lever is disengaged from the spring and turned round until it points upward, as shown in the cut. The lever is then worked by hand a few times until the brake rigging is slack enough to allow the new shoes to be put on. The hook is then turned back to its original position, and if there is too much slack left the lever is worked a few times by hand, until the slack is taken up, and the hook then again hung onto the spring.

SEWAGE PURIFICATION IN AMERICA.

(Continued from page 521.)

Electrical Treatment at Brewsters, N. Y.

Although there is but a small amount of sewage, from some 35 buildings, only, to be treated at Brewsters, the plant is of unusual interest, for two reasons: (1) Because it is the first attempt to use an electrical process for this purpose, other than in an experimental way; and (2) because, from a strictly engineering standpoint, the construction of these works is the first decided step which New York city has taken to permanently protect its water supply.

Brewsters is a small village located within the Croton drainage area of the water-works of New York city, about 50 miles from the Grand Central depot. The village is located on the east branch of the Croton River, about two miles below the Sodom and Bog Brook reservoirs, known as double reservoir I. From the Sodom reservoir the water flows in the natural channel of the east branch six miles to its junction with the middle and west branches, some eight miles above the head of Croton Lake, from which the old and new Croton aqueducts lead to the city.

In 1891, Mr. E. W. Martin, Chemist of the New York Health Department, and Mr. A. L. Beebe, Assistant Chemist, made a sanitary survey of the Croton watershed. In Mr. Martin's official report on the survey, dated Nov. 15, 1891, the sanitary condition of the east branch, below the Sodom Dam, is thus described:

> Its only tributary of importance below the reservoir is Tonetta Brook, which flows through and drains the western portion of Brewsters, and joins the river at the southwest extremity of the town. This brook is practically the public sewer of that portion of the town through which it flows, as will be seen from the record of inspections below. The configuration of the land is such that the general drainage of Sodom and Brewsters toward the river.

From the inspections mentioned in the quotations, it appears that on Aug. 21, 1891, there were some 25 distinct sources of actual or probable contamination of Tonetta Brook, comprising ten privies, a sewer from a business block of ten houses, including a hotel, and another sewer from a block of six houses. All of these sources of contamination, except a barn 200 ft. away, were either directly at the brook or within 100 ft. of it.

In addition to the pollution of Tonetta Brook there was some direct pollution of the river. After receiving the sewage of Brewsters, the river flows about twelve miles before reaching the head of Croton Lake.

Acting under the recent legislative bill providing for the purification and protection of the Croton watershed, the Department of Public Works of this city, under the direction of Commissioner M. T. Daly and Chief Engineer Geo. F. Birdsall, has within the past few months abated the worst, if not all, of these nuisances. This has been effected by condemning all buildings within 250 ft. of the east branch and by providing a sewerage system with a scheme for the disinfection and deodorization of the sewage, with subsequent discharge into open trenches several hundred feet from the river. It was at first proposed to dispose of the sewage on land, but the land available was not considered suitable, upon examination. The sewage must eventually go into the river, whatever the mode of treatment.

The process used for the electrical treatment of sewage at Brewsters has been developed by Mr. Albert E. Woolf, of 104 Washington street, New York city. Salt is added to water at the rate of 160 lbs. per 1,000 gallons. The resultant brine is electrolized, and the decomposed product is discharged directly into the sewer. To effect this spring water is piped a few hundred feet into a 4,500-gallon wrought iron tank, just outside the building which shelters the plant, and flows thence into a 3,000-gallon wooden mixing and reserve tank, placed a few feet above the floor of the building. Salt is shoveled into a measuring box which is lifted by a pulley rope, and has a gravity tip into the mixing tank when the top is reached. From the mixing tank the brine flows into the treatment and supply tank, through the bottom of the latter. A 20-HP. horizontal boiler furnishes steam to a 15-HP. engine, which in turn drives a 4-HP. dynamo having the low potential of 5 volts, but giving a current of 700 amperes. The dynamo was built by the Zucker Levitt Co., of New York city. The boiler and engine are provided with a view to the future increase of the amount of sewage to be treated. The current passes through a positive electrode of copper, plated with platinum, and a negative electrode of carbon, both immersed in the tank. The decomposed water and salt is discharged into the 4-in. outlet sewer, with the object, as already stated, of destroying all the germs and deodorizing the sewage.

The outlet sewer discharges into an open trench some 200 ft. long, from which four trenches about 75 ft. long have been excavated at right angles to the main trench. These trenches are about 3½ ft. wide and 4 ft. deep, and are located in meadow land perhaps 500 ft. from the river. Whether the trenches will remain open is yet to be decided by the Department of Public Works.

As originally devised the process described above was designed to produce a disinfectant and deodorant by means of the decomposition of sea water by electrolysis. The available data regarding the nature of the process and the value of the resultant relate to the product derived from sea water. The results of both chemical and bacteriological examinations seem to show that the latter product is an admirable disinfectant. Regarding the composition of a sample of sea water before and after electrical treatment by this process and the value of the resultant as a disinfectant, Mr. Martin, already mentioned above, in a report to Dr. Cyrus Edson, then Sanitary Superintendent of New York, stated on Oct. 19, 1892:

> I have the honor to report the following results of the examination of samples of water taken at the foot of Rector St., from North River, before and after its partial decomposition by an electric current:

	Before.	After.
Grains per gallon of chlorides calculated to chloride of sodium........	1,318.45	896.08
Hypochlorites calculated to hypochlorite of sodium..................		391.00
Available chlorine..................		186.32

> From the above analysis the effect of the electric current appears to be:
>
> (1) Decomposition of the chlorides, bromides and iodides, with the production of chlorine, bromine and iodine.
>
> (2) The water becomes neutral or faintly alkaline.
>
> (3) The formation of hypochlorites, hypobromites, etc.
>
> When a solution of hypochlorite of sodium is brought in contact with organic matter a decomposition at once takes place.
>
> While it is impossible to state just what the reaction would be, it is probably as follows: Part of the chlorine in the hypochlorite replaces a part or the whole of the hydrogen in the organic substance; another portion unites with the liberated hydrogen, and, as in bleaching, ozone is produced, which, in its turn, acts on the organic matter. In other words, the organic material, be it organized, as in the lower forms of vegetable life (viz., bacteria, etc.), or non-organized, as in the solid or suspended matter of sewage, is decomposed, and if sufficient hypochlorites be present the organic matter is permanently disinfected.
>
> In my opinion, the solution in question will prove an absolute disinfectant, if applied in sufficient quantities to organic matter either of animal or vegetable origin.

Until biological and chemical analyses of the treated and untreated sewage at Brewsters have been made final judgment cannot be passed upon the practical value of the process, as now developed.

The plant was built by the Woolf Electric Disinfecting Company for the New York Department of Public Works at a contract price of $5,000, including nothing but the building and inclosed apparatus described above. The contractors state that the actual cost of constructing the plant was between $6,000 and $7,000.

The coal consumption at Brewsters is stated to be about one ton a week.

It is stated that 1 gallon of the salt and water is used to each 100 gallons of sewage, which is at the rate of 10,000 gallons of the mixture to 1,000,000 gallons of sewage. At the rate of 160 lbs. of salt electrolized with 1,000 gallons of water the amount of salt per 1,000,000 gallons of sewage is 1,600 lbs. With salt at $4 per ton, the cost of salt for 1,000,000 gallons of sewage would be $3.20, or about 10 cts. per capita per year on a basis of a little less than 100 gallons of sewage per capita. To this must be added the cost of coal, labor, water and some minor incidentals, while for the treatment of sewage on a large scale some means of deposing and removing sludge would doubtless be necessary, which would still further add to the operating expenses.

In many or most localities it would be necessary to buy water, which, at the above rate of water consumption, some 9,000 gallons per 1,000,000 gallons of sewage, would be of no small item.

It seems probable that further experiments will demonstrate that the salt can just as well be added directly to the sewage. Indeed, there would seem to be a decided advantage in such a method, as the electricity would then act directly upon the sewage. In the electrical processes which have been tried experimentally the electrodes have been placed in the sewage.*

At a public exhibition of the Brewsters plant on July 6 the writer found the treated sewage to be practically inoffensive. It was very cloudy, as would be expected from the nature of the treatment.

RAILWAY EXCURSIONS TO THE WORLD'S COLUMBIAN EXPOSITION.

The question of special excursion rates to encourage the exposition traffic was discussed in our issue of June 1, and a liberal policy was adopted July 11 at a meeting of presidents of roads belonging to the Trunk Line Association. A resolution was passed authorizing the running of special trains, composed only of day cars, to Chicago, on a schedule of not less than 30 hours, at a rate of one limited fare for the round trip by the route traveled. The tickets are to have a return limit of ten days, and not to be good on sleeping, parlor, or chair cars, and no stop-over will be permitted in either direction. These special excursion trains will begin running on July 24, and, according to present arrangements, will continue for one month, unless otherwise ordered. Two excursions will be run on Mondays, Tuesdays, Wednesdays and Saturdays of each week, to be alternated by the several lines. Tickets will be sold for children between five and twelve years at 75% of the one-way rate. Personal baggage not to exceed 100 lbs. in weight will be allowed with each excursion ticket.

The resolution authorizing these cheap excursions was adopted without a dissenting vote. The Grand Trunk Ry. withdrew its objection to the proposition prior to the meeting, and Mr. Fowler, President of the New York, Ontario & Western Ry., after stating his objections to the plan, announced that his road would not stand out against all the rest. Mr. Fowler said, however, according to press reports: "I feel convinced that the proposed reduction is a serious mistake and will create another of those unfortunate precedents which tend to the permanent reduction of rates, already so low in our country as to make the question of net profits a somewhat uncertain quantity." In the discussion preliminary to the vote on the resolution Mr. Depew argued strongly in favor of the half-fare tickets. He said that public sentiment demanded cheaper fares to the Exposition, a fact which was plainly indicated by the very general advocacy of reduction in rates by the newspapers.

By the terms of the resolution adopted passengers can go from New York to Chicago and return for $20 over the New York Central R. R. and the Pennsylvania R. R., for $17 over the New York, Ontario & Western R. R., and for $18 on all other trunk lines..

Two cast steel frames for a hydraulic riveter were lately shipped from the Midvale Steel Works, at Nicetown, Philadephia, to Messrs. Bement, Miles & Co., of the latter city. Each of these steel castings was 23 ft. 2 ins. long by 73¾ ins. wide, and the pair weighed 45,000 lbs. Test bars cut from the casting previous to annealing gave a tensile strength of 89,660 lbs. per sq. in., and an extension of 22.67% and contraction 41.07%. A hydraulic cylinder of cast steel was also shipped from the same works weighing 16,594 lbs. and giving in test bars cut before annealing a tensile strength of 92,350 lbs. per sq. in. with 21.20% extension and 30.85% contraction.

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*For descriptions of other processes for the electrical treatment of sewage and water, none of which have ever passed the experimental stage, so far as our knowledge goes, see the accounts of the Webster process in Eng. News, April 13 and Oct. 26, 1889; the Hardie process, Eng. News, Feb. 2, 1889; the process of the Electrical Water Purification Co., Eng. News, May 17, 1890. The first two processes are of English invention; the company named was located at Philadelphia in 1870.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

BALTIMORE & OHIO.—Construction has been commenced on the extension of this line in Ohio between Wooster and Millersburg, 18 miles, and the grading is expected to be completed in 60 days.——Tracklaying on the State Line branch between Morgantown, W. Va., and Uniontown, Pa., has been commenced. The tunnel near Harper's Ferry will be about 800 ft. in length and is reported as nearly completed.

NEW YORK, NEW HAVEN & HARTFORD.—The citizens of Woodbury, Conn., are endeavoring to secure an extension of this road to the town from some point on the Naugatuck division.

OHIO SOUTHERN.—The extension of this railway to Lima, O., has been completed to St. Paris, with the exception of the terminals at St. Paris. It is reported that regular trains will be run as far as the road is completed, as soon as it has been ballasted. Surveys have been completed for the extension from Lima to Toledo.

PENNSYLVANIA.—A report from Greensboro, Md., states that an extension about a mile in length will soon be made from the Delaware & Chesapeake to the canning establishment of A. B. Roe.

TOLEDO & OHIO.—Rails are being laid on the extension of this road between Columbus, O., and Ridgeway, a distance of 46 miles.

WILKES BARRE & EASTERN.—The rails have been laid on this road between Wilkes Barre, Pa., and Stroudsburg, Pa., 60 miles, eastward from Wilkes Barre 20 miles to an iron and steel viaduct 1,650 ft. long, and westward from Stroudsburg to within four miles of the viaduct.

Projects and Surveys.

CHICAGO, UNION CITY & CINCINNATI.—J. C. Fawcett, Pres., Louisville, is reported as stating that the necessary financial assistance has been secured for the construction of this proposed railway from Union City, Ind., to Huntington, Ind., a distance of 80 miles. I. Frank White, Ch. Engr., Union City, Ind.

KENDALLVILLE, ROCHESTER & WESTERN.—It is reported that Boston capitalists are organizing a company to build a railway from Kendallville, Ind., through the counties of Noble, Kosciusko, Fulton, Pulaski, Jasper and Newton to the Illinois state line; capital stock, $3,600,000.

NEW CUMBERLAND & PITTSBURG.—M. J. Becker, Ch. Engr., Pittsburg, informs us that this road as located will be 16 miles in length and extend on the left bank of the Ohio River through the towns of Georgetown, Skippingport, Bellowsville and Philipsburg. The maximum grade will be 0.5% and the maximum curve 4°. Notice of incorporation was published in our issue of June 29.

ST. MARY'S & SOUTHWESTERN.—Incorporated in Pennsylvania to operate a steam railway in Elk Co.; capital stock, $300,000; Pres., B. Frank Hall, St. Mary's, Pa.

Southern.—Existing Roads.

JACKSONVILLE, ST. AUGUSTINE & INDIAN RIVER.—It is reported that this road has been completed south to Eau Gallie, Fla., and that a line of steamers will be put on the Indian and Jupiter rivers between Eau Gallie and Jupiter to connect with the Palm Beach line, which will soon be constructed between Jupiter and Palm Beach.

RALEIGH & WESTERN.—Ten miles of this road have been graded between Egypt and Asboro, N. C. Many bridges will be required.

Projects and Surveys.

CHATTANOOGA WESTERN.—We are informed by T. J. Nicholl, Pres. and Ch. Engr., Chattanooga, Tenn., that the surveys are about half completed for this road, which is proposed from Chattanooga to Walden's Ridge mines and connecting with the Cincinnati Southern near Hixson, Tenn. The route is through a mountainous country and has a maximum grade of 3% and maximum curve of 10°. There will be one bridge 2,600 ft. long across the Tennessee River. Hamilton Co. has voted $150,000 of 5% bonds to aid the project, and it is thought that contracts for the construction will be awarded this fall, tracklaying commenced next year and the road completed in 1896.

GULF & FLORIDA NORTHERN.—Horace Tucker, Supt. of admissions at the World's Fair, has been elected president of this company, which was incorporated several years ago to construct a railway from St. Andrew's Bay, Fla., to Apalachicola, Fla., a distance of 215 miles. According to press reports, the state is to give the company 10,000 acres of land for every mile of road built. The line will pass through fine forests of cedar and good orange country, and it is stated that the construction which was begun some years ago has been resumed.

JELLICO, BIRD EYE & NORTHERN KY.—Incorporated in Kentucky to operate a road which has been built by the Jellico & Bird Eye Coal Co. from Jellico, Tenn., to Bird Eye, Ky., seven miles; capital stock, $100,000; Pres., E. T. Halsey, Louisville, Ky.

LOUISVILLE & JEFFERSON TERMINAL RY.—Incorporated in Kentucky by Dennis Long, S. A. Miller, W. L. Lyons and others, of Louisville; capital stock, $100,000.

Northwest—Existing Roads.

CANADIAN PACIFIC.—The extension of this road from Pasqua, Assiniboia, to connect with the Minneapolis, St. Paul & Sault Ste. Marie extension at the International boundary line, a distance of 161 miles, has been completed to the bridge over the Souris River, near Estevan, and will soon be completed to the boundary line. It is reported that the rails are considerably heavier than those on the main line, the roadbed is three feet wider than any other line in Manitoba, and there is over 80 miles northwest from near Estevan that is without a curve.

CHICAGO & NORTHWESTERN.—A report from Casper, Wyo., states that this company has secured land near Bessemer, southwest of that city, for the location of a town. Two corps of surveyors are at work setting the grade stakes between there and South Pass and several contractors have recently been over the route. Every indication points to the early construction of the line to Ogden, Utah, about 300 miles.

GREAT NORTHERN.—According to a press dispatch the grading on the extension of this road from Park Rapids to Leech Lake, Minn., has been completed as far as Akeley, 20 miles from Park Rapids. This grading has been done by Foley Brothers & Guthrie, of St. Paul, and most of the work was done in the months of May and June with from 700 to 1,000 men. No more grading will be done at present and no arrangements are being made to lay the rails on this grade. It is not likely that the road will be completed and trains put on for some months. There are to be three stations on the road, one at Elbow Lake, one near Sand Lake, and one at Akeley, the terminus. It is not known when the road will be built to Leech Lake.

ILLINOIS CENTRAL.—This road is to be abandoned, according to reports, between West Lebanon and Le Roy, Ill., and extended from Potomac to Danville, Ill.

RICE LAKE, DALLAS & MENOMINEE.—The contract for the first section of this road between Rice Lake and Dallas, Wis., is reported to have been awarded to St. Paul parties. H. E. Clark, Ch. Engr., St. Paul.

ST. LOUIS & EASTERN.—This railway has been completed between Marine and East St. Louis, Ill. It is 11 miles long and was built mainly to reach the mines of the Madison Coal Co.

WINONA & SOUTHWESTERN.—Work has been commenced upon the extension recently surveyed from Osage to Mason City, Ia.

YANKTON, NORFOLK & SOUTHWESTERN.—A press dispatch states that arrangements have been made for completing this road between Yankton, S. Dak., and Norfolk, Neb., a distance of 64 miles, and that the track will be laid this summer. A. K. Nash, Ch. Engr., Yankton, S. Dak.

Southwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—The tracklaying on the extension from Bowie to Fort Worth, Tex., 70 miles, has been completed to Fort Worth, and it is intended to open the line July 15. The road is laid with 60-lb. steel rails and heavy white oak ties, 2,800 to the mile.

GULF, BEAUMONT & KANSAS CITY.—This company is reported as having on hand at Beaumont, Tex., and Algiers, La., sufficient rails to build the first 20 miles of road, the construction of which was recently commenced.

LA PORTE, HOUSTON & NORTHERN.—This road was graded last year from Harrisburg, Tex., to La Porte, Tex., about 17 miles, and it is reported that tracklaying will be commenced this month. The company is amending its charter to permit an extension from La Porte to Alexandria, La.

PARAGOULD & NORTHEASTERN.—This road, formerly the Paragould & Buffalo Island, has been purchased by a syndicate headed by J. F. Hasty & Sons, Paragould, Ark., and is being changed to standard gage from Paragould to the St. Francis River, a distance of ten miles. It is reported that a drawbridge will be built across the river in the fall and the road extended two miles further.

ST. LOUIS SOUTHWESTERN.—New car shops, to cost $75,000, will soon be constructed by this company at Pine Bluff, Ark., according to reports.

SHERMAN, SHREVEPORT & SOUTHERN.—This company has filed a mortgage for $3,100,000 to secure funds to extend its road to Shreveport, La., and to Decatur, Tex.

VELASCO TERMINAL.—The directors and stockholders of this railway have voted unanimously to issue $20,000 per mile of first mortgage bonds on all the road now finished and to be constructed, the money to be used in extensions not yet made public. It was decided to leave the choice of route for the extension entirely to the directors. Many of the stockholders favor building a branch from Angleton Station to Alvin, on the Gulf, Colorado & Santa Fe, and thereby secure another route from Velasco to Houston. The majority, however, it is reported, advocate extending the main line from Chenango Junction, on the International & Great Northern, to Arcola Junction, on the same road and the Gulf, Colorado & Santa Fe.

Projects and Surveys.

LAFOURCHE, RACELAND & LOCKFORT.—Organized at Thibodeaux, La., to construct a railway along the Bayou Lafourche, from Lafourche Crossing to Lockport and Longueville. A bridge will be built over the Bayou Lafourche at Raceland, where the road will connect with the Southern Pacific; Pres., Leon Godchaux; Secy. and Treas., Chas. Godchaux.

TEXAS.—A company has been organized at Ballinger, Tex., with a capital stock of $2,000,000, to build a railway for that city to Abilene, a distance of about 35 miles.

Rocky Mt. and Pacific.—Existing Roads.

BELLINGHAM BAY & EASTERN.—It is reported that construction will soon be commenced on an extension of this road around Lake Whatcom, Wash., to connect with the Seattle, Lake Shore & Eastern at Wickersham, Wash.

Projects and Surveys.

DENVER, SALT LAKE & SAN FRANCISCO.—Incorporated in Colorado to build a railway from Denver to Salt Lake City and thence to San Francisco; capital stock, $10,000,000; incorporators, John Evans, W. N. Byers, E. W. Rollins, Geo. Tritch and others. It is reported that the directors of the company are worth $50,000,000, and that engineers will commence at once the selection of the route.

Foreign.

MEXICAN NATIONAL.—A press report from Matamoras, Mex., states that work on the road between that city and Monterey will be resumed at once. The government concession of $9,000 per mile will expire in 1896, and under the present arrangement with the government the company is required to build a certain amount per year on the various roads owned by it. All the other roads have been completed, and this one will be built at least to Laredo as soon as possible.

STREET RAILWAYS.

WEST BUXTON, ME.—The survey has been made for the proposed electric railway from Bar Mills to Bonney Eagle along the eastern shore of Saco River. Specifications are being prepared and bids for the construction will soon be received by the railroad committee at this place.

DEDHAM, MASS.—The Norfolk Suburban St. Ry. Co., referred to last week, has been granted a charter and has received concessions from Boston, Hyde Park and this city for the proposed road, which will be constructed at once.

WATERTOWN, MASS.—This town has granted a location for the tracks of the Newtonville & Watertown St. Ry. Co., which proposes to construct an electric railway to Boston.

BROOKLYN, N. Y.—The state railroad commission will give a hearing in this city July 25 on the application of the King's Co. Electric R. R. Co., the Nassau Electric R. R. Co., the Broadway R. R. Co., the Coney Island, Fort Hamilton & Brooklyn R. R., and the Broadway Ferry & Metropolitan Ave. R. R. Co., all of this city, for permission to use electricity as a motor power, on the application of the Brooklyn City R. R. Co. for permission to use electricity on proposed new routes, and on the application of the Montauk Extension R. R. Co., for permission to construct its proposed road.

BUFFALO, N. Y.—The survey of the South Shore & Hamburg Electric R. R. has been completed by Smith & Hoffeld. The line will run from the city line at South Ave., through Limestone to Blasdell, to Woodlawn Beach and Bay View. Work on the road will be begun at once, and it will probably be completed by next spring.

GRAND ISLAND, N. Y.—The Grand Island Electric Belt Line Co. has been incorporated; capital stock, $24,000; directors, J. D. Scanlon, Syracuse; F. T. Gates, Medina; F. B. Gibbs, Buffalo, and others.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Co. has accepted the franchise granted by the council and the construction of the road will be commenced as soon as possible. This company was recently incorporated by B. F. Low and others to build an electric railway ten miles long. It is reported that S. W. Roberts and M. G. Wightman, representing the Johnson Co., Cleveland, O., are pushing the project.

POUGHKEEPSIE, N. Y.—The Poughkeepsie & Wappingers Falls St. Surface Co. and the South Ave. Surface R. R. Co. have been granted an extension of time for beginning and completing the construction of their roads. Construction on the South Ave. Surface R. R. has been commenced. The City R. R. will be reconstructed, a 70-lb. girder rail being used, and new branches will be built, the whole aggregating seven miles in length, all to be electrically equipped. Lawlor & House are the engineers.

SYRACUSE, N. Y.—Surveys for the proposed Syracuse, Fayetteville & Manlius electric railway are being made by Miller A. Smith, New York. Bids are being received for the construction and E. W. Emmons, Gen. Man., hopes to have the road completed this fall.

ALTOONA, PA.—The Altoona & Logan Valley Ry. Co., which was incorporated to construct an electric railway from this city to Hollidaysburg, 6½ miles, and to Bellwood, seven miles, has applied for permission to issue $500,000 of 5% gold bonds. The money is to be used to equip the line and to pay for the City Passenger Ry., of this city, which has been acquired by the company.

TOWANDA, PA.—Bids will soon be received for constructing and equipping an electric railway. Pres., G. W. Kipp.

TYRONE, PA.—A charter has been granted to the Tyrone Electric St. Ry. Co. for an electric railway about 15 miles long; capital stock, $300,000; Pres., G. W. Burket; directors, S. B. Templeton, James Pritchard, W. F. Wise, and others, all of this city.

YORK, PA.—Charters have been granted to the York & Wrightsville Electric Ry. Co., capital stock, $75,000; York & Manchester Electric Ry. Co., capital stock, $50,000, and to the York & Dover Electric Ry. Co., capital stock, $50,000. These railways will connect several of the outlying districts near York with the county seat.

ATLANTA, GA.—Work will begin in a few days on the electric railway to Salt Springs, a distance of about 20 miles. Henry Camp, Pres., Covington, Ga.; B. F. Curtis, Gen. Man., Atlanta.

MERIDIAN, MISS.—The Edison Electric Light & Power Co., of this city, is making arrangements to construct an electric railway as soon as the necessary right of way has been secured.

IRONTON, O.—The franchise of the Ironton St. Ry. Co. has been extended 30 years and the company has agreed to put electric motors on the entire line before April next. The T rail will be used under certain conditions and the road will also be extended.

WARREN, O.—A franchise has been granted to the Warren-Sharon Electric St. Ry. Co. Construction must begin not later than Aug. 1, 1894, and the franchise requires the completion of the section between Warren and Brookfield by Dec. 1, 1895, and from there to Sharon by Dec. 1, 1896. The fares to be charged are as follows: From Warren to Howland, 5 cts.; to Vienna, 10 cts.; to Brookfield, 15 cts.; to Sharon, 20 cts. At Brookfield a branch will run to Youngstown by way of Hubbard. The fare from Brookfield to Hubbard will be 5 cts., and to Youngstown 10 cts.

NOBLESVILLE, IND.—The commissioners of Hamilton county, Ind., have granted the perpetual right of way to the Chicago & Central Indiana Electric Ry. Co. over all the highways of the county. This grant is of great value to the company, and gives it the right of way to within eight miles of Indianapolis.

ALTON, ILL.—The Alton Electric St. R. R. Co. will soon begin work on the State St. road and expects to have all the lines completed by September. The company is arranging to place four engines in its powerhouse, two for the street railways and one each for arc and incandescent lighting.

BELLEVILLE, ILL.—The city council has adopted an ordinance for a belt railway to connect the Cairo Short Line and Air Line railways at the Switzer Mill, on West Main St.

CHICAGO, ILL.—The Chicago City Ry. Co. is reported as stating that since the electric cars have been running on 47th and 35th streets the traffic has doubled, and that it has decided to retire all its horse cars as soon as possible, substituting electricity as the motive power.

LOS ANGELES, CAL.—The board of supervisors has voted to advertise the sale of a franchise for a double track electric railway between this city and Pasadena.

SAN FRANCISCO, CAL.—The franchise granted to the San Francisco & San Mateo Electric Ry. Co. for a road from Baden to Redwood City has been declared forfeited by the supervisors of San Mateo county. Richard Joost, president of the road, is reported as stating that the line is shortly to be extended to Baden, but that is as far as the company desires to build at present.

LONDON, ONT.—It is stated that the city wishes 12 additional miles of street railway. Col. Jas. M. Clark, Windsor, is looking the ground over with regard to a system of electric railways.

HIGHWAYS.

NEW JERSEY.—The town of Mount Arlington has voted to issue bonds for $20,000 for the construction of highways.

INDIANA.—Bids will be received until July 22 for building 26,450 lin. ft. of the Pipe Creek & Hackleman free gravel road; estimated cost, $12,782. Ansel R. Smith, Engr., Auditor's office, Marion, Ind.

TEXAS.—The board of trade of Terrell has appointed committees to superintend the work of improving all the highways leading to the city.

BRIDGES.

BRIDGEPORT, CONN.—The following bids for the construction of an iron and steel draw bridge, complete, over the Housatonic River, between the towns of Stratford and Milford, were received by D. M. Rowland June 29, 1893, and the contract was awarded to Dean & Westbrook, for plan B, New York, July 3, 1893.

Groton Bridge & Mfg. Co., Groton, N. Y......	$90,650
Massillon Bridge Co., Massillon, O............	90,800
Canton Bridge Co., Canton, O..................	93,000
Toledo Bridge Co., Toledo, O..................	93,450
King Iron Bridge Co., Cleveland, O..........	89,999
Dean & Westbrook Co., New York, N. Y., A, $89,500; B., $88,900; C, $84,500; D,	90,000
Berlin Iron Bridge Co., East Berlin, Conn.....	89,600
Buddington Bridge Co., New Haven Conn., A, $90,000; B, $90,500; AA, $89,500; BB,	90,000
Penn Bridge Co., Beaver Falls, Pa..........	91,099
R. F. Hawkins, Springfield, Mass.............	92,000
J. H. Tower, Providence, R. I.................	93,000

BROOKLYN, O.—The Commissioners of Cuyahoga Co. will receive bids until July 19 for a bridge across Big Creek Valley in Brooklyn township. A. E. Aikins, Co. Aud.

TACOMA, WASH.—Bids will be received until Aug. 5 for a wrought iron highway bridge across the ship channel. Further particulars will be found in our "Engineering News" columns. James M. Morrison, Cy. Engr.

WATER-WORKS.

HANOVER, N. H.—The citizens have voted to issue bonds for $20,000 and Dartmouth College has appropriated $30,000 for works, for which bids are now being received. Prof. R. Fletcher, Engr.

BARTON LANDING, VT.—The village has voted to purchase the local works for $3,800 and to put in a new system for fire protection. A reservoir will be constructed and bonds issued for $12,000.

BURLINGTON, VT.—The citizens have voted unanimously to issue bonds for $65,000, to be expended principally in extending a 24-in. cast iron intake pipe about 2¼ miles into the lake. The work will be advertised as soon as the exact location has been agreed upon and specifications prepared. About 7,000 lin. ft. of 10-in. 55 and 60-lb. cast iron pipe will also be laid.

RUTLAND, VT.—The city council has been authorized to spend $50,000 for extensions.

BOSTON, MASS.—The water board will receive bids until July 17 for a masonry dam in the town of Southboro. The work includes 230,000 cu. yds. earth excavation, 13,400 cu. yds. rock excavation, 14,000 cu. yds. concrete masonry, 22,200 cu. yds. rubble masonry, etc.

BROCKTON, MASS.—Lewis Hawes, Boston, has reported that the proposed new main will cost $65,379 for a 20 and 24-in. pipe, or $70,511 for 24 and 30-in.

MALDEN, MASS.—The commissioners have recommended that $5,000 be appropriated for experiments, one-half to be expended at Martin's Pond and the other half within three miles of city hall.

NORWOOD, MASS.—It is reported that the commissioners are about to lay three miles of additional mains.

WALPOLE, MASS.—At a special meeting July 6 the citizens voted, 102 to 87, against the construction of works, for which authority had been granted.

WEBSTER, MASS.—A special town meeting was held July 13 to vote on the question of works.

ROCKVILLE, CONN.—The Rockville Water & Aqueduct Co. has awarded the contract for 10¾ miles of pipe, 1,232 tons, to the Radford Pipe & Foundry Co., Radford, Va., and that for gates and hydrants to the Ludlow Valve Mfg. Co., Troy, N. Y. The contract for pipelaying will soon be awarded.

ANDOVER, N. Y.—The citizens have voted in favor of works to cost $15,000 to $20,000.

COHOES, N. Y.—The board is considering the purchase of a new pump and a 150-HP. water wheel.

HOOSICK FALLS, N. Y.—The Hoosick Falls Water Supply Co. is erecting a new building at the station and will put in a new boiler and engine.

MIDDLETOWN, N. Y.—An election will be held July 25 to vote on extensions to cost $150,000. About four miles of 3-ft. pipe, a small dam and 1,600 ft. of tunnel are included in the plans.

ST. JOHNSVILLE, N. Y.—The citizens have voted to issue bonds for $25,000 for works.

ALLEGHENY, PA.—The select council has passed a resolution to employ an engineer to prepare plans and specifications for new works.

GETTYSBURG, PA.—The Gettysburg Water Co. has voted to increase its capital stock fom $24,000 to $45,000.

HARRISBURG, PA.—The council has voted to submit to the voters a proposition to issue bonds for $75,000 for a new pumping engine.

MAHANOY CITY, PA.—The Mahanoy City Water Co. has purchased 21 acres of land in East Union township upon which to build a dam and erect a pumping station.

McKEESPORT, PA.—The superintendent has been directed to advertise for bids until July 17 for a pumping station.

PITTSBURG, PA.—Owing to a mistake of our printer the bids of the Groshon High-Duty Pumping Engine Co. New York, at $176,800, and of the Holly Mfg. Co., Lockport, N. Y., at $147,820, were omitted from those published last week for the construction of two 10,000,000-gallon, high-duty pumps at the Brilliant Station.

SEWICKLEY, PA.—The commission desires bids for filtering and purifying the supply.

BERKLEY, VA.—The South Norfolk Water & Electric Light Co. has purchased five acres of land in this town for its plant.

BERKELEY SPRINGS, W. VA.—The Berkeley Springs Water-Works & Improvement Co. has awarded the contract for works to Jas. Lockhead, Washington.

KEYSER, W. VA.—Surveys for works are about completed, and the contract for reservoir and three miles of trench has been awarded to G. B. Shank.

WINSTON, N. C.—The Winston Water Co. desires bids for a system of wells and pumping plant of 1,000,000 gallons daily capacity.

NEWNAN, GA.—Bids will be received until July 24 for works, as stated in our advertising columns. M. W. Dairs, Engr.

JACKSONVILLE, FLA.—It is reported that a 1,000,000-gallon reservoir will be constructed.

ORANGE CITY, FLA.—The water-works company is considering plans for extensions and the erection of a 1,000,000-gallon stand-pipe.

THIBODEAUX, LA.—A committee has been appointed to negotiate for works.

HARRIMAN, TENN.—Resolutions have been passed to advertise for bids for works.

MORRISTOWN, TENN.—The citizens have voted to issue bonds for works.

FALMOUTH, KY.—A company has been incorporated to construct works; capital stock, $20,000.

BROOKLYN, O.—Bids will be received until Aug. 8 for mains in several streets. C. N. Collins, Vil. Clk.

HILLSBORO, O.—Bids are asked until Aug. 8 for $75,000 of water-works bonds. N. H. Ayres, Vil. Clk.

NORWOOD, O.—Bids are asked until July 24 for $25,000 of water-works bonds. W. E. Wichgar, Clk., 137 Walnut St., Cincinnati.——An election was held July 12 to vote on the issue of $50,000 of additional bonds.——Bids for the covered reservoir and tank were received from L. Schreiber & Sons, Geo. Stacey Mfg. Co., Cincinnati, and Ritter & Conroy, Pittsburg, the lowest bid being not quite $20,000.

SPRINGFIELD, O.—The trustees have decided to sell but $2,000 of bonds for extensions. The fund now contains $3,000.

MARION, MICH.—It is reported that works will soon be constructed.

CHICAGO, ILL.—Bids will be received until July 20 for extension of mains to the district about Roseland and also to the northwest district.——The estimated receipts of the water office for the year ending July 1, 1894, are placed at $2,980,000, and the expense estimates include the following: Completing Lake View tunnel, $100,000; completing 68th St. tunnel, $160,000; repair and maintenance of pipe, $351,000; operating pumping stations, $595,000; balance left for extensions of new work, $654,500.

OTTAWA, ILL.—Bonds will be issued for $60,000 for works, and it is reported that contracts for the construction will be awarded as soon as the plans are completed.

QUINCY, ILL.—The contract with the Water-Works Co. has expired and the city is reported as unable to agree upon new rates.

CUDAHY, WIS.—Plans for works have been completed and the contracts for construction will soon be awarded.

DES MOINES, IA.—The council has voted that the city should own its own works.

GIRARD, KAN.—Extensions are proposed, the work including a 10-in. well 800 ft. deep, 24-ft. octagon brick tower 80 ft. high to carry a 24 × 18-ft. tank, new pumps, 350,000-gallon reservoir and about two miles of pipe. The tower will have buttresses at each corner, forming panels at the top and enlarged to a projection of 32 ins. beyond the main wall at the bottom. The lower floor will be used as an engine room. The weight on the brick work, with full tank of water, will be below 5 tons per sq. ft. at the base. Such a tower was found cheaper than a trestle work of steel of same dimensions. G. W. Pearsons, Consult. Engr., Kansas City, Kan.

HORTON, KAN.—It is reported that works will soon be constructed.

BELLE FOURCHE, S. DAK.—The Belle Fourche Water Co. has been incorporated; capital stock, $10,000.

BONHAM, TEX.—The city council has purchased 200 acres of land for the site of proposed works.

SAN ANTONIO, TEX.—The citizens have voted to issue bonds for works.

WAXAHACHIE, TEX.—It is reported that Dallas contractors have submitted a proposition to the council for works.

ALAMEDA, CAL.—The council is considering plans for works.

FAIRMOUNT, CAL.—The Thompson Water Co. has been incorporated; capital stock, $5,000.

PASADENA, CAL.—The tunnel of the Lake Vineyard Land & Water Co. is to be extended.

SAN FRANCISCO, CAL.—The Spring Valley Water Co. is reported as about to make important extensions.

VALLEJO, CAL.—Contracts have been awarded as follows: A. Le Jeune, Vallejo Terra Cotta Works, excavating trenches, at $5,278; Phillips & Searl, San Francisco, diverting dam, at $4,047, also the contract for reservoir, at $30,486, as noted in our issue of June 29.

ARTESIAN WELLS.

KANGLEY, ILL.—Bids will be received until July 18 for a 12 to 6-in. well. N. E. Tobias, Vil. Clk.

OAKLAND, CAL.—The Alvarado Artesian Water Co. has been incorporated by John T. Bradley, J. F. Uhlhorn and others; capital stock, $3,000,000.

IRRIGATION.

NEW COMPANIES.—Mulberry Creek & Arkansas River Irrigation Co., Ford, Kan.; $10,000; J. M. Imel, A. L. Imel, Ford; Samuel P. Yeaker, Kansas City, Mo.——Allen Water Ditch Co., Salem, Ore.; $1,000; C. J. Allen, J. W. Allen.——Union Irrigation Co., Union, Ore.; $5,000; E. F. Springer, Jas. Raymond, G. M. Irwin.——Tulare Investment & Irrigation Co., San Francisco, Cal.; $750,000.

SEWERS.

BEVERLY, MASS.—The board of selectmen will receive bids until July 26 for the construction of sewers. E. W. Bowditch, Engr., Boston.

BOSTON, MASS.—The following bids were opened July 1 for the plant at the Charlestown pumping station: Southwark Foundry & Machine Co., Philadelphia, $39,375; Holly Mfg. Co., Lockport, N. Y., $42,000; The Edward P. Allis Co., Milwaukee, $35,000.

HUDSON, MASS.—Plans for a system are being considered.

MEDFORD, MASS.—It is reported that a system will be constructed at once.

WATERBURY, CONN.—The commissioners have voted to construct two sewers,, and to continue the Benedict outfall at an estimated cost of $4,000.

ALBANY, N. Y.—Bids will be received at the Home Savings Bank until July 18 for sewers and drains west of the Erie Canal. John F. Shafer.

BUFFALO, N. Y.—The contracts for two sewers have been awarded to Thomas McKeown, at $51,861.

CLINTON, N. Y.—The citizens have voted in favor of the proposed system; estimated cost, $17,000 to $23,000. It is reported that the construction will soon be commenced.

CORTLAND, N. Y.—July 6 the citizens voted, 379 to 310, in favor of issuing bonds for $70,000 for a system.

ILION, N. Y.—The contract for about 10.6 miles of pipe sewers has been awarded to John Ryan, Albany, at $39,407. Anthony Steber, Secy. Comrs.

JAMESTOWN, N. Y.—The board of public works has received the following bids for a section of the new system: Ryder & Fitzgerald, Dunkirk, plan No. 1, $54,301; No. 2, $56,801; W. H. Roberts, Pittsburg, No. 1, $61,150; No. 2, $59,810.

NEW YORK, N. Y.—Bids will be received until July 18 for constructing a sewer in Vanderbilt Ave., East. Louis F. Haffen, Comr., 2622 Third Ave.

ROCHESTER, N. Y.—Ordinances have been passed for 18 to 10-in. pipe sewers in nine streets; estimated cost, about $25,000.

ST. JOHNSVILLE, N. Y.—The citizens have voted to issue $30,000 of bonds for sewers, and the contract will be awarded at once, it isreported.

TROY, N. Y.—The council has voted to construct two tile and six brick sewers.

UTICA, N. Y.—The city surveyor is making surveys for a sewer from the canal to the river.

WHITE PLAINS, N. Y.—The sewer committee has been authorized to receive bids for sewer mains in Fisher Ave.

NEWARK, N. J.—The council has voted to construct sewers in four streets.

MIDDLETOWN, PA.—The Middletown Drainage Co. has been incorporated by Geo. F. Mish, C. E. Pease, T. M. Yost and others, to construct a system of sewers; capital stock, $15,000.

MOUNT CARMEL, PA.—The Mount Carmel Sewer Co. has been organized by Jos. Gould, T. M. Righter, Wm. Kiefer, Jr., and others.

MACON, GA.—The sewer committee has appointed a committee of five to consider plans for the proposed system for which $200,000 of bonds have been voted. Chn., S. B. Price.

NASHVILLE, TENN.—The Nashville Sewerage Co. desires bids for 14,000,000 or more sewer brick.

CANTON, O.—The council committee has recommended that the citizens vote on the question of $75,000 of bonds for sewers in Shriver's Run.

CINCINNATI, O.—The board of administration will receive bids until July 28 and 29 for pipe sewers.

HAMILTON, O.—John W. Hill, Cincinnati, estimates the cost of the proposed system at $325,000.

NILES, O.—Alexander Potter, New York, has presented plans for a complete system; total length, 17.8 miles; estimated cost, $88,790.

TOLEDO, O.—Bids will be received until July 17 and 31 for brick sewers. Sylvester Lamb, Cy. Clk. The council has voted to construct 13 sewers.

WARREN, O.—Plans are being made for sewers for the West Side.

INDIANAPOLIS, IND.—The board of public works has voted to construct a main sewer, 4,609 ft. long in Clifford Ave.

BELLEVILLE, ILL.—Surveys for the proposed system have been completed.

LA CROSSE, WIS.—The board of public works has been instructed to prepare plans for 24 to 15-in. pipe sewers.

WHITEWATER, WIS.—Plans for a system have been completed.

MINNEAPOLIS, MINN.—The council has voted to ask for bids for 300,000 sewer brick.

TOPEKA, KAN.—The council has voted to purchase about a carload of 9-in. sewer pipe.

FARGO, N. DAK.—Bids are asked until July 31 for five lateral sewers. Sewer bonds for $13,000 will soon be issued. A. O. Rupert, Cy. Aud.

PARIS, TEX.—C. Delafield, New York, has been in the city to estimate the cost of a system.

SAN ANTONIO, TEX.—The citizens have voted to issue bonds for surveys for a system.

TORONTO, ONT.—Bids will be received by the city engineer until July 22 for a stormwater sewer.

STREETS.

WESTERLY, R. I.—The council has been petitioned for an extension of the system of macadamized roads.

BUFFALO, N. Y.—The Barber Asphalt Paving Co. has been awarded contracts for paving eight streets, at $156,171; German Rock Asphalt & Cement Co., four streets, at $96,278; Buffalo Paving Co., two streets, at $27,604.

NEW YORK, N. Y.—The department of docks will receive bids until July 20 for paving 9,087 sq. yds. with granite blocks, including 4,625 sq. ft. cross walks, 43,200 gallons paving cement, etc.

ROCHESTER, N. Y.—The council has voted to pave Warwick Ave. with asphalt; estimated cost, $21,000; also to pave Compbell St. with asphalt.

SYRACUSE, N. Y.—Bids will be received until July 17 for paving two streets with Trimidad Lake asphalt H. F. Stephens, Cy. Clk. Additional work has been ordered.

ELIZABETH, N. J.—Bids are asked until July 31 for paving two streets; 2,900 sq. yds. telford 15 ins. deep, 2,130 sq. yds. trapblocks, 3,300 lin. ft. curbing reset, etc. N. K. Thompson, St. Comr.

ALLEGHENY, PA.—The contract for repaving Main St. with Ligonier blocks has been awarded to Sloan & McIlwaine, at $27,000.

EDGEWOOD, PA.—The council is receiving bids for grading the streets of the borough.

NEW CASTLE, PA.—Bids will soon be asked for about two miles of brick paving with stone curbing.

PITTSBURG, PA.—The council has voted to curb, pave and lay flagstone sidewalks in two streets.

NEWPORT, KY.—The following bids have been received for paving with brick: York St.—Pugh & Campbell, Porter standard, $33,455; Porter repressed, $34,225; Standard Cons. Co., Parto, $37,565; T. P. Shanks' Metropolitan, $38,632. Washington Ave.—Pugh & Campbell, Porter standard, $56,820; Porter repressed, $56,129; Charles Spints & Son, Grant's Star-Hallwood block or Parto block, $64,533; Thomas P. Shanks, Metropolitan, $65,219. Isabella St.—Pugh & Campbell, Porter standard, $27,525; Porter repressed, $28,218; J. M. Peter, Hallwood or Grant's Star, $31,167; John Trapp, Metropolitan or Hallwood, $33,500. Fourth St.—Pugh & Campbell, Porter standard or repressed, $28,937; John Trapp, Hallwood or Metropolitan, $31,935.

CLEVELAND, O.—The council has voted to pave two streets with Medina sandstone and one with brick; also to grade certain streets.

COLUMBUS, O.—The Acme Paving Co. has been incorporated by F. M. Pickering, M. E. Murphy, Wallace Kilpinski, Alva Coe and C. E. Blue; capital stock, $10,000.

TOLEDO, O.—Bids are asked until Aug. 7 for paving two streets with asphalt, Medina stone, cedar blocks or brick. Sylvester Lamb, Cy. Clk.

ELWOOD, IND.—Bids are asked until July 17 for paving two streets with brick. O. A. Armfield, Cy. Clk.

FORT WAYNE, IND.—Bids will be received until July 25 for grading seven streets and paving two with vitrified paving brick. F. M. Randall, Cy. Engr.

INDIANAPOLIS, IND.—The board of public works will receive bids until July 19 for paving with asphalt.

GRAND RAPIDS, MICH.—H. A. Collar, Cy. Engr., informs us that the city will award contracts for about $100,000 worth of work after improvement bonds have been sold. These bonds were recently issued, but have not yet been sold.

IONIA, MICH.—Bids will be received until July 27 for grading, curbing with sandstone and paving with cedar blocks in East Main St., about 12,000 sq. yds.

STREATOR, ILL.—Bids are asked until July 17 for paving in one street, and until Aug. 7 for improving about 12 streets. W. J. Zilm, Cy. Clk.

KEOKUK, IA.—The city engineer has been directed to prepare plans and to advertise for bids for paving several streets.

DULUTH, MINN.—The council has voted to grade and pave one street each with cedar blocks and macadam. The city engineer has prepared plans for grading Sixth St.; estimated cost, $32,479 or $33,769.

WEST DULUTH, MINN.—The village engineer is preparing plans for paving several streets with cedar blocks.

BUTTE, MONT.—The council has voted to pave several streets with cedar blocks.

KANSAS CITY, MO.—The board of public works will receive bids until July 18 for grading, curbing, paving and constructing sidewalks, five contracts.—The Barber Asphalt Co. has been awarded contracts for paving four streets with asphalt, at $103,427.

ST. LOUIS, MO.—The board of public improvements has been petitioned to pave 16 streets with asphalt.

TACOMA, WASH.—The board of public works is receiving bids for improving South Thirty-fourth St.; estimated cost, $20,000.

LOS ANGELES, CAL.—The council has been petitioned to extend Franklin St. by a tunnel not to be over 800 ft. long. The council has voted to grade five streets, and gravel and curb three.

ELECTRIC LIGHT AND POWER.

LANSING, MICH.—The citizens have voted to issue bonds for $60,000 for a municipal electric light plant.

KIRKWOOD, MO.—The Suburban Electric Light Co. has accepted a franchise for lighting the town by electricity, and will begin work at once upon the extension of its wires from Webster Groves to this place.

COLORADO CITY, COLO.—The contract for electric street lights for ten years has been awarded to the Colorado City Glass Co. The El Paso Electric Co., Colorado Springs, has had the contract for the past five years, at $13 per month for each arc light, and bid $10 per month for the new contract. A stone power house is being constructed by the Colorado City Glass Co., and the entire plant will soon be completed.

PHOENIX, ARIZ.—Contracts for 1,200 c. p. arc lights for one year have been awarded to the Phoenix Light & Power Co. and the East End Electric Light Co. at $8 per light per month for 12 lights each.

WINDSOR, ONT.—Thos. Chater, Ch. Engr., has recommended that the city purchase a new 150-HP. engine for use at the electric light plant.

CONTRACT PRICES.

SEWERS.—Fort Collins, Colo.—We have received from L. G. Carpenter, Engr., a statement of the bids received for a sewer system to connect the State Agricultural College with the river. Bids were asked for the completed work, including all material and work excepting manholes, for pipe alone, and for sewer complete excepting pipe. The following were the bidders: 1, G. C. Kelley, Fort Collins; 2, M. O'Rourke, Denver; 3, Igo & Howard, Greeley; 4, J. M. Gleason & Son, Denver; 5, Campbell, Woods & Co., Denver; 6, Chas. Sullivan, Denver; 7, J. B. Hindry, Denver; 8, L. M. Hovey, Pueblo; 9, Clough & Davidson, Colorado Springs; 10, J. J. Fleetford, Denver. The prices for the completed work are given below, the four columns at the right being for the sewer complete excepting pipe:

	1	2	3	4	5	6	7	8	9	10	2	4	5	8
12-in. main, 4,650 lin. ft. at	$1.05	$0.79	$2.00	$0.98	$0.97	$1.25	$0.85	$0.73	$0.95	$1.09	$0.53	$0.70	$0.64	[illegible]
10-in. " 1,650 " "	1.00	0.64	2.00	0.50	0.63	1.05	0.80	0.68	0.75	0.98	0.43	0.26	0.36½	0.38
10-in. laterals, 560 " "	1.00	0.64	1.00	0.50	0.63	0.95	0.80	0.68	0.75	0.86	0.40	0.26	0.36½	0.33
8-in. " 700 " "	0.50	0.34	1.00	0.32	0.53	0.85	0.50	0.46	0.60	0.59	0.20	0.25	0.35½	0.29
6 in. " 1,000 " "	0.42	0.29	0.80	0.32	0.45	0.60	0.45	0.36	0.54	0.59	0.19	0.25	0.33	0.25
4-in. " 1,400 " "	0.38	0.18	0.55	0.32	0.27½	0.50	0.40	0.24	0.48	0.48	0.12	0.25	0.20	0.15
Manholes, 21, each..............	55.00	33.00	45.00	50.00	34.00	40.00	45.00	40.00	35.00	50.00	33.00	50.00	34.00	40.00

For pipe alone, to be delivered f. o. b. cars in this city Geo. N. Steinmetz, Denver, bid as follows: 12-in., 30 cts.; 10-in., 24 cts.; 8-in. 16 cts.; 6-in. 10.5 cts.; 4-in. 7 cts.; E. R. Barkley, Fort Collins, bid for Blackmer & Post pipe, 33, 26.4, 17.6, 12 and 8 cts., respectively; J. C. Whedbee, Fort Collins, bid for Blackmer & Post pipe, 35, 28, 18.6, 14.4 and 11 cts., and on Dickey pipe, 32.6, 26.4, 17.5, 13.6 and 10.1 cts., respectively.

SEWERS.—St. Paul, Minn.—Bids were opened July 3 for a sewer estimated to cost $53,000. George L. Wilson, Supt. of Sewers, informs us that the top of the sewer will be flat and made of steel I beams and brick arches. The bids were as follows: I. D. Moran, excavation, 20,000 cu. yds., at 50 cts.; piping, 36,000 lin. ft., at 20 cts.; timber, 274 M. ft. B. M., at $19; masonry walls, 3,500 cu. yds., at $6; concrete, 700 cu. yds., at $5; brickwork, 275 M., at $13; steel I beams, 192,000 lbs., at 2¾ cts; wrought iron, 18,000 lbs., at 3 cts.; cast iron, at 2 cts.; vitrified brick paving, 80 M., at $20; granite block paving, 500 sq. yds., at $3; total, $59,401. John Nevins, 34 cts., 17½ cts., $19.50, $4.75, $5, $12.75, 2½ cts., 3 cts., 2 cts., $19, $1.70, $49,784, respectively.

Montclair, N. J.—The following bids were opened July 10 for 6,925 lin. ft. of 24-in. vitrified pipe sewer, the bidders being (1) Westbrook & Pistowen, (2) Conover & Newton, and (3) Thos. J. Reagan:

	1.	2.	3.
24-in. pipe sewer, per lin. ft.........	$2.55	$2.70	$3.19
Y's, in excess of sewer cost.	1.00	4.00	3.50
M'holes under 12 ft., per vert. ft...	3.50	3.50	3.00
Manholes more than 12 ft...... ...	3.70	5.00	3.70
Lampholes, per vert. ft............	1.00	2.00	2.20
Concrete, per cu. yd......	5.00	3.50	5.00
Brick mas., Ros. cem., per cu. yd...	10.00	15.00	18.00
Rock excavation, per cu. yd......	3.75	3.50	5.00
Iron castings, per lb...............	0.02¼	0.04	0.03
Iron pipe substituted, per gr. ton..	36.00	25.00	40.00
Timber foundations, per M. ft.....	25.00	15.00	25.00
Hemlock sheathing, per M. ft......	18.00	32.00	22.00
Spruce sheathing, per M. ft., B.M.	23.00	33.00	25.00
Excav. below grade, per cu. yd...	1.00	3.60	1.50
6-in. tile, per lin, ft......	0.50	0.90	.60

St. Joseph, Mo.—The following bids for sewer construction were opened by City Engineer Campbell July 7 and contracts awarded to the lowest bidder in each case: Andrew Sheridan, St. Joseph: (1) Blackstone Creek sewer, 14½ × 17 ft., 4-ring brick, $26.90 per lin. ft.; (2) Mitchell Ave. sewer, 13 × 15 ft., 4-ring brick, $16.90 per lin. ft. Geo. T. Nelles, Denver, Colo.: (1) $24.81, (2) $19.25. C. W. Nowland, St. Joseph: (1) $24.43, (2) $17.43. P. Morley, St. Joseph: (2) $15.45. W. E. Gibson, St. Joseph, (2) $21.40.

BRICK PAVING.—Hornellsville, N. Y.—The contract for improving Main St. has been awarded to (1) Horner & Co., Olean, at $55,216, the other bids being as follows: 2, A. D. Osborn, Binghamton, $67,875; 3, C. H. Hartshorn, Hornellsville, $66,422; 4, Costellos & Neagle, Elmira, $67,642; 5, P. B. McNaughton & Co., Buffalo, $62,387; 6, A. J. Hines & Co., Corning, $60,045. The prices given are all for Preston brick. F. A. Dunham, Engr.

	1.	2.	3.	4.	5.	6.
Excav., 6,000 cu. yds., at..	$0.30	$0.36	$0.35	$0.48	$0.39	$0.45
Paving, 25,000 sq. yds., at.	1.88	2.22	2.32	2.24	2.13	2.00
Curbing, 9,000 lin. ft., at..	.55	.79	.50	.75	.60	.49
Curbing reset, 100 lin. ft. .	.05	.60	.10	.20	.20	.10
Cir. curbing, 180 lin. ft....	.65	1.25	1.00	1.40	1.25	.75
Drain tile, 8,400 lin. ft.....	.10	.25	.13	.19	.12	.10
Special brick, 7,200 lin. ft..	.07	.10	.075	.02	.02	.45

Connellsville, Pa.—A contract for paving 11,200 sq. yds. with vitrified brick has been awarded to R. J. Hallem & Sons, at $1.96 per sq. yd.

Lincoln, Neb.—A contract has been awarded for paving with two courses of brick on sand, at $1.80 per sq. yd.

PAVING BRICK.—Baltimore, Md.—The following bids have been received for 25,000 brick for repaving East Lexington and Harrison Sts.: Burns, Russell & Co., $11 per M.; National Building Supply Co., $11; John N. Foss & Son, $10.50; Wm. H. Perot, $12 and $13; James R. Busey & Son., $9.69; Daniel Donnelly, $9.95; Smith & Schwarz Brick Co., $11.75; J. J. Hoffman, $9.50. For vitrified brick for paving St. Paul St. the prices ranged as follows: Shale Brick Exchange, Canton, O.; $16.50 to $19.50 per M. on cars; National Building Supply Co., Canton shale brick, $21.90 delivered on the street; S. M. Hamilton & Co., $19 and $21.50 on the street; J. A. Hayden, $20 on cars; D. A. Fenton, Hallwoood blocks, $25 per M. on the street, or $1.10 a sq. yd. on the work.

CEDAR BLOCK PAVING.—Detroit, Mich.—The lowest bids for paving several streets with cedar blocks ranged from $1.35 to $1.50 per sq. yd.

Minneapolis, Minn.—For paving three streets with cedar blocks. James E Snyder bid 96.5 and 97.5 cts. per sq. yd., and Janney Bros. 97.5 cts.

ASPHALT AND GRANITE PAVING.—Lancaster, Pa.—A contract for paving with asphalt has been awarded to Frank Hinden, at $2.42 per sq. yd., other bids ranging from $2.445 to $2.84. A contract for paving with Belgian blocks has been awarded to Steinwondel & Pfeffer, at $2.55 per sq. yd.

MISCELLANEOUS.

GAS COMPANY.—Charleston, W. Va.—The West Virginia Fuel Gas Co., of this city, has been incorporated by D. H. Oxley, Moses W. Donnelly, R. J. Herdon and others.

DREDGING—Albany, N. Y.—Bids are asked until July 18 for dredging 22,500 cu. yds. from the east channel of the Hudson River, at Stuyvesant, and 15,000 cu. yds. from the west channel at Coxsackie. Edward Hannan, Supt. Pub. Wks.

LOCK.—Florence, Ala.—The contract for the large lock of the Colbert Shoals Canal, about 22 miles above this city, on the Tennessee River, has been awarded to M. V. Henry, Birmingham, at $343,342. The itemized bids received for the work were published in our issue of June 1.

PARKS.—Franklin, N. H.—It is proposed to lay out about 120 acres on the shore of Webster Lake into a park to be known as Webster Park. About half the shore line will be sold in lots for cottages, and the remainder will be reserved for the public and the interior gradually improved. G. H. Allen, Manchester, is the designing engineer.

Malden, Mass.—The park commissioners have recommended that bonds be issued, not to exceed $25,000, for park purposes.

SEAWALL.—Bridgeport, Conn.—The council has voted to give the park commissioners $10,000 to repair a seawall.

ELEVATOR.—New Orleans, La.—James Stewart & Co., St. Louis, have been awarded a contract by the Illinois Central R. R. for a 300,000-bushel elevator to be erected in this city. It will adjoin the freight house of the Mississippi Valley R. R., and be fitted with modern machinery throughout.

GARBAGE CREMATORY.—Portland, Ore.—Bids will be received until July 22 for the erection of a furnace for the cremation of city garbage. Bids must be accompanied with plans and specifications, and state the capacity of proposed crematory; also contain a certified check for $500, and be addressed to the committee on health and police, auditor's office.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Richmond Locomotive Works, Richmond, Va., are building 6 passenger engines for the Seaboard Air Line and 3 engines for the Mississippi River & Bonne Terre; also 30 ten-wheel express passenger engines for the Cleveland, Cincinnati, Chicago & St. Louis.

The Schenectady Locomotive Works, Schenectady, N. Y., have built an eight-wheel passenger engine for the Adirondack & St. Lawrence.

The Waco & Northwestern will purchase a freight locomotive.

The Union Pacific has built at its shops at Omaha, Neb., a consolidation engine for hauling heavy trains over the steep grades of the divide.

CARS.—The Jackson & Sharp Co., Wilmington, Del., is building 4 Allen hotel cars of the type described in our issue of April 20.

The Allison Mfg. Co., Philadelphia, Pa., has an order for 100 coal cars for the Westmoreland Coal Co.

The Lebanon Mfg. Co., Lebanon, Pa., is building 250 freight cars for the Beech Creek.

The Madison Car Co., Madison, Ill., has made an assignment, but the assignee may run the works to complete contracts, and as these will occupy two months it is expected that by then there will have been made arrangements for the permanent settlement of present difficulties.

STEEL TIES.—The Standard Steel Railway Tie Co., New York, has acquired the patents and business of the Standard Metal Tie & Construction Co. The Standard steel tie was illustrated and described in our issue of Feb. 7, 1891.

THE RIEHLE BROS. TESTING MACHINE CO., Philadelphia, Pa., has an order from the Civil Engineering Department of Cornell University for a 400,000-lb. vertical screw power testing machine with all the latest automatic and electric attachments, recording diagram apparatus and special tools for testing girders up to 18 ft. in length, transversely; also for crushing columns 10 ft. high, and for applying tensile strain to rods, bars, etc., 10 ft. long, stretching them, if necessary, 25% of their length before breaking. This machine is said to be the largest screw power testing machine in the country, if not in the world. The company not long ago placed a horizontal hydraulic testing machine of 400,000 lbs. capacity in the Boston Navy Yard. It weighs by means of scale levers, and is said to be the largest hydraulic machine with levers in the United States.

NEW COMPANIES.—Standard Air Brake Co., New York, N. Y.; $5,000,000; W. W. Shaw, Hackensack, N. J.; George E. Madden, Plainfield, N. J.; George H. Graham, East Orange, N. J. Gravity Turntable Co., Albany, N. Y.; locomotive turntables; Stephen Allen, H. G. Modine and Wm. G. Sanders. Union Tie & Lumber Co., Chicago, Ill.; $300,000; C. H. Remy, B. McWilliams and G. W. McClellan. Chicago Tin Plate Mfg. Co., Chicago, Ill.; $25,000; J. C. Benton, C. D. Miller and N. D. Lewis. Keystone Lead & Zinc Co., Joplin, Mo.; $5,000; E. O. Bartlett, C. B. Nickerson and F. C. McCown. North Shore Co., Chicago, Ill.; $400,000; wharves, docks, etc.; Edwin McNeal, G. E. Rensman and N. W. Hacker.